Image Degradation Analysis (IDA): Forensic Applications for Light Physics, White Paper

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Physiological Advisory: The Biology of Belief
The following text challenges established paradigms and may contradict your first learned beliefs. This encounter will likely trigger a biological response. Because modern education conditions the mind to associate being wrong with punishment, your brain perceives conflicting data as a survival threat. This activates **Cognitive Impasse**, a physiological defense mechanism where cognitive inertia, dissonance, bias, and avoidance function as a single, integrated framework. This impasse often begins with an automatic urge to ridicule, dismiss, and laugh at new ideas or information that contend with your established beliefs (academic, cultural, professional, religious) to relieve internal tension, a reflex that frequently transitions into anger; but self-awareness can mitigate and ease these symptoms.

If you persist, this biological defense may escalate into visceral symptoms like a tight gut, headaches, or profound feelings of guilt and impending doom. Before this peak, a stage called **Cognitive Dissonance Avoidance** occurs, manifesting as a sudden compulsion to escape. You may feel abruptly sleepy, confused, or desperate for distraction. This is not boredom, but rather a survival mechanism masking itself as fatigue to protect your mind from the visceral pain of *possibly being wrong*. During this stage, the brain can become temporarily impaired that you may lose the ability to comprehend the evidence or even the literal meaning of the words being read or said. To understand this text, you must recognize that a feeling of exhaustion or doom is not evidence of falsehood, nor is it evidence of truth; but rather the feeling of a mental boundary developing.

*Genuine insight is rarely a matter of raw brilliance, but rather the grit to **"stay with the questions much longer."** For many, **"the only thing that interferes with my learning is my education,"** as formal schooling often prioritizes obedience over the true **"measure of intelligence,"** which is **"the ability to change your mind,"** as reflected in the beliefs of Albert Einstein. This mental flexibility is accessible to anyone, whether through formal study or as an autodidact, yet it remains rare within the rigid dogma of academia or any corpora. As Max Planck famously observed, **"science progresses one funeral at a time,"** because the hardest part of learning is often the willingness to outlive the paradigms we were taught.*

Lehti, Andrew (2025). Cognitive Impasse [Visual]: Stages of Mental Rigidity, Dissonance, and Bias. figshare. Figure. https://doi.org/10.6084/m9.figshare.30016195

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Methodology

This research investigates motives, behaviors, and observations by deliberately delaying exposure to academic and institutional findings. By utilizing an extrapolative trial by error approach, the study minimizes the anchoring biases and standardized obedience that typically restrict the thought process. This isolation ensures that the initial synthesis of data remains unpolluted by the biological defense mechanisms, such as the ***Cognitive Impasse***, often triggered when a researcher is tethered to a specific institutional paradigm. Following the independent completion of the study, academic material is reviewed comprehensively to evaluate alignment. Typically, the findings correspond closely with established principles, with exceptions limited to nuanced insights not yet formally recognized but widely observed in society

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About Author

Andrew Lehti is an independent researcher and polymath autodidact who has dedicated over 35,000 hours to **Metopedia**, a research journey designed to diagnose the **Cognitive Impasse**. This research identifies the impasse as a physiological defense cycle that forces the mind to reject information contradicting first learned beliefs. The work argues that modern education is a system of **Standardized Obedience** that conditions the brain to perceive error as a survival threat. By associating intellectual deviation with punishment, this systemic conditioning triggers biological resistance such as the involuntary urge to mock new ideas or the onset of brain fog to avoid the pain of cognitive dissonance.

Lehti utilizes a methodology termed **Extrapolative Trial by Error**, which intentionally bypasses academic literature during initial investigations to prevent anchoring bias. This approach has led to the development of the **Canonical Order of Operations** in mathematics and the use of the **Codex Amiatinus** to identify critical linguistic mistranslations in historical religious texts. He has authored proprietary tools including **Image Degradation Analysis (IDA)** for forensic inquiry and the **Polyhedral Index Partition (PIP)** for calculating integer partitions. Through these diverse applications, the work seeks to provide the cognitive tools necessary to dismantle the collective mental rigidity that governs both individual behavior and institutional dogma.

The materials published by Andrew Lehti reflect an interdisciplinary approach spanning mathematics (classical, algebraic, and computational), investigative history, linguistics with an emphasis on translation and reconstruction of religious texts, cognitive psychology and philosophy of mind, and the philosophy of education, objectivity, exploration, and metacognition.

Abstract

Modern digital forensics often relies on Error Level Analysis (ELA) to detect local splicing anomalies. However, ELA is insufficient for evaluating the physical authenticity of a scene's global illumination. This paper introduces Image Degradation Analysis (IDA), a forensic framework formerly designated as Photoelectromagnetic (PEM) Image Analysis. IDA operates on the premise that light leaves a physical "fingerprint" on surfaces; a geometric energy distribution that becomes visible when an image is subjected to extreme algorithmic stress. By utilizing a standardized compression coefficient of $Q = 5$ IDA isolates the mathematical skeleton of light diffusion, enabling analysts to distinguish between the parallel, chaotic signature of natural sunlight and the localized, geometric uniformity of artificial lighting.

1. Introduction

Modern image forensics often relies on Error Level Analysis (ELA) to detect digital splicing. However, ELA is limited in its ability to evaluate the physical authenticity of a scene's physical attributes. Originally designated as Photoelectromagnetic (PEM) Image Analysis, the methodology has been refined into Image Degradation Analysis to focus specifically on the interaction between light and intensity under stress. IDA operates on the principle that consistent, natural light sources degrade in predictable, chaotic ways, whereas artificial or edited elements reveal smooth edges and geometrically uniform patterns.

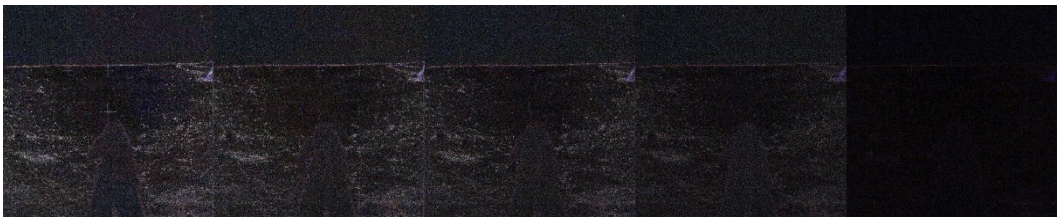


Figure 1. A breakdown of ELA performance across five key milestones: *at 60%, 70%, 80%, 90%, and 98%*

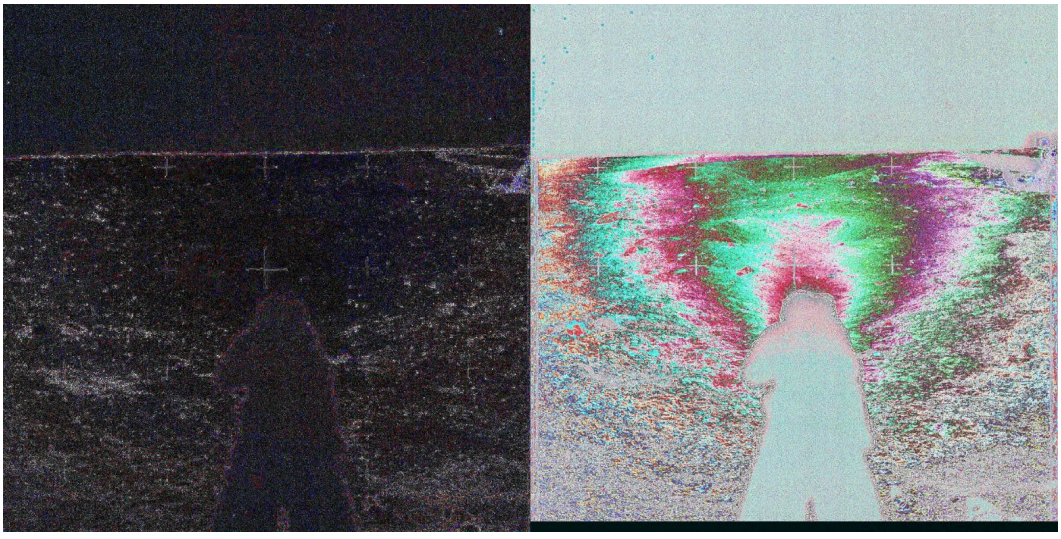


Figure 2. Analyzing the critical differences between ELA (left) and IDA (right). Though they are related, they serve different forensic functions.

1.1 The Physics of Digital Light

The fundamental challenge in digital forensics is determining whether a captured scene adheres to the physical laws of optics and radiative transfer. Traditional metadata analysis cannot verify if a scene was staged using artificial lighting to mimic a natural environment. IDA provides a physics-based framework to analyze how light is absorbed, reflected, and refracted within a frame by subjecting the digital data to extreme algorithmic stress.

Figure 3. IDA of dancers under dual-source backlighting

1.2 From ELA to IDA

While IDA functions similarly in principle to Error Level Analysis (ELA), it differs fundamentally in its intensity and forensic objective:

1. Error Level Analysis (ELA): Focuses on identifying local inconsistencies in compression history to detect spliced or "pasted" elements.

2. Image Degradation Analysis (IDA): Utilizes severe degradation and intensity mapping to detect global lighting irregularities, such as simulated sunlight.

1.3 The Forensic Objective

The primary goal of IDA is to identify inconsistencies in light source characteristics. By breaking an image down into its fundamental like-colors, researchers can evaluate the "fingerprint" left by light on various surfaces.

Natural Sunlight: Characterized by complex, turbulent light signatures, spiky patterns, and specific color spectrum shifts. **Artificial Light:** Characterized by uniform, geometrically perfect patterns consistent with light bulbs or spotlights.

When applied to official Apollo mission photos, IDA revealed that the "sun" depicted in lunar surface images often degrades into patterns consistent with artificial light sources, rather than the turbulent signature of the actual sun captured in orbital control groups.

2. Mathematical Methodology

To ensure high reproducibility, IDA utilizes a fixed mathematical engine for extraction and amplification.

The following represents the standardized mathematical methodology for Image Degradation Analysis (IDA), alongside its practical translation into Adobe Photoshop and general image-editing workflows.

2.1 Standard Mathematical Methodology (IDA)

This process is designed to be exact and reproducible across any digital environment, following the specific logic established in the IDA forensic framework.

The Degradation Function (I_{deg}): A duplicate of the original image (I_{orig}) is compressed using the JPEG algorithm at a fixed quality level (Q) of 5 out of 100.

$$I_{deg} = \text{JPEG}(I_{orig}, Q = 5)$$

Difference Map Extraction (Δ) The mathematical absolute difference is calculated for every pixel (i) across the Red, Green, and Blue channels.

$$\Delta R_i = |R_{orig} - R_{deg}|, \quad \Delta G_i = |G_{orig} - G_{deg}|, \quad \Delta B_i = |B_{orig} - B_{deg}|$$

The Scaling Constant (S) To amplify the result for visual analysis, a scaling factor is derived from the Factor (m) and the Degradation (x) strength. The exact internal scale constant used for standard IDA ($m = 4, x = 5$) is defined as:

$$S = m \times (x \times 5) \times 47$$

With standard values: $S = 4 \times 25 \times 47 = 4,700$

Normalization and Clipping The final output pixel is normalized against the maximum difference found in the image ($maxDiff$) to ensure the results utilize the full 8-bit dynamic range.

$$P_{final} = \text{clamp}\left(\Delta \times \frac{S}{\max(maxDiff, 1)}, 0, 255\right)$$

2.2 Photoshop Translation

To perform a manual IDA pass in Photoshop, translate the mathematical steps into the following layer and adjustment operations:

Step	Mathematical Action	Photoshop Equivalent
1. Compress	$I_{deg} = \mathrm{JPEG}(Q = 5)$	Save a copy of your original as a JPEG. Set Quality to 5 (when max quality is 100).
2. Align	Overlay I_{deg} on I_{orig}	Import the compressed JPEG back into your original file as a new layer directly above the original.
3. Diff	$\Delta = \lvert\lvert I_{orig} - I_{deg}$	Set the Layer Blend Mode of the top (compressed) layer to "Difference." The screen will likely appear mostly black.
4. Flatten	Prepare for scaling	Create a new merged layer of the result (Shift + Ctrl + Alt + E / Cmd + Option + Shift + E).
5. Scale	Apply S (Amplification)	Add an Exposure Adjustment Layer. Increase the Exposure slider 12.0. The Factor (m) correlates to the intensity of this slider.
6. Gamma	Curve Correction	Adjust the Gamma Correction slider within the Exposure layer (or the midpoint in Levels) to a value of 0.5

3. Standard Methodology

To make sure these tests are accurate, we use a process that gives the same results every time. If two different people use the same photo and follow these steps, their final images will be identical. This reliability is important for any scientific study.

3.1 The Standard Mathematical Process (IDA55)

The most common version of this test is known as the IDA55 protocol. The name comes from the specific settings used during the analysis. It uses a set of math rules to find and highlight hidden patterns in the light.

1. Creating the Copy: We start by making a duplicate of the original photo. We save this copy as a JPEG with a quality level of only 5 percent. This is a very low setting. It forces the computer to create specific digital marks based on the light and color in the original image.

2. Finding the Difference: We compare the new low-quality copy to the original photo. By subtracting the values of one from the other, we create a difference map. This map acts like a mathematical skeleton of how light was moving in the scene.

3. Making it Visible: At first, these differences are usually too dark for the human eye to see. We use a specific scaling factor to multiply the values and make them bright. For the standard IDA test, we use a specific constant to ensure the hidden details are clearly visible.

4. Final Polishing: The last step is to normalize the image. We stretch the values so that they use the full range of light and dark. This makes the resulting forensic map much easier to analyze.

3.2 Manual Application in Photoshop

You do not need complex code to run this analysis. You can perform an IDA pass manually using standard photo editing software like Photoshop. It follows the same basic logic as the math-based version but uses tools familiar to editors.

Generate a low-fidelity reference by exporting the source image as a 5% quality JPEG. Import this file into the workspace as a discrete layer, positioned directly above the high-resolution original.

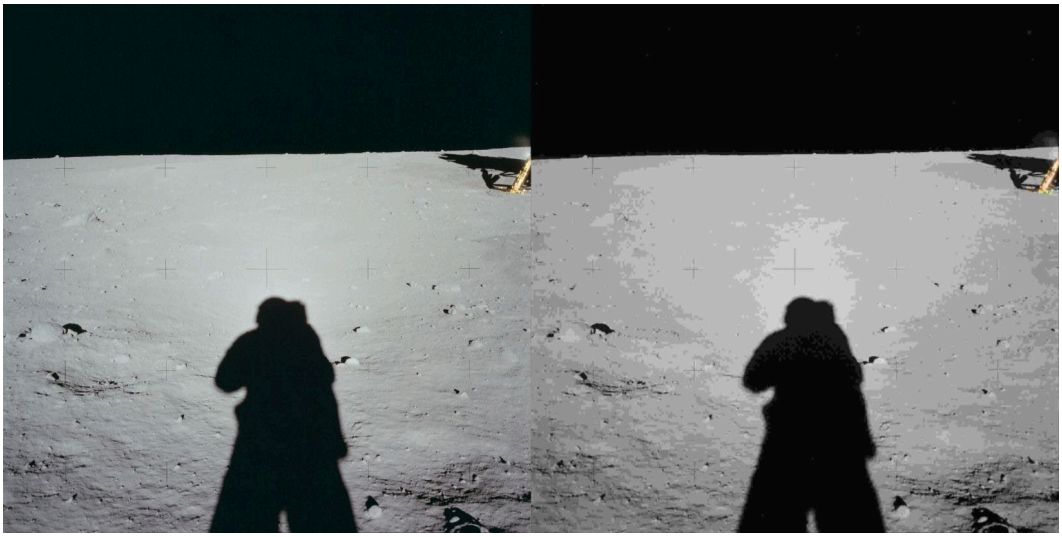


Figure 4. Source image (left) compared against a high-compression version at 5% quality (right)

apply the **Difference** blending mode to the upper layer; since identical pixels subtract to zero (black), only the specific artifacts and degradation from the low-quality compression remain visible.

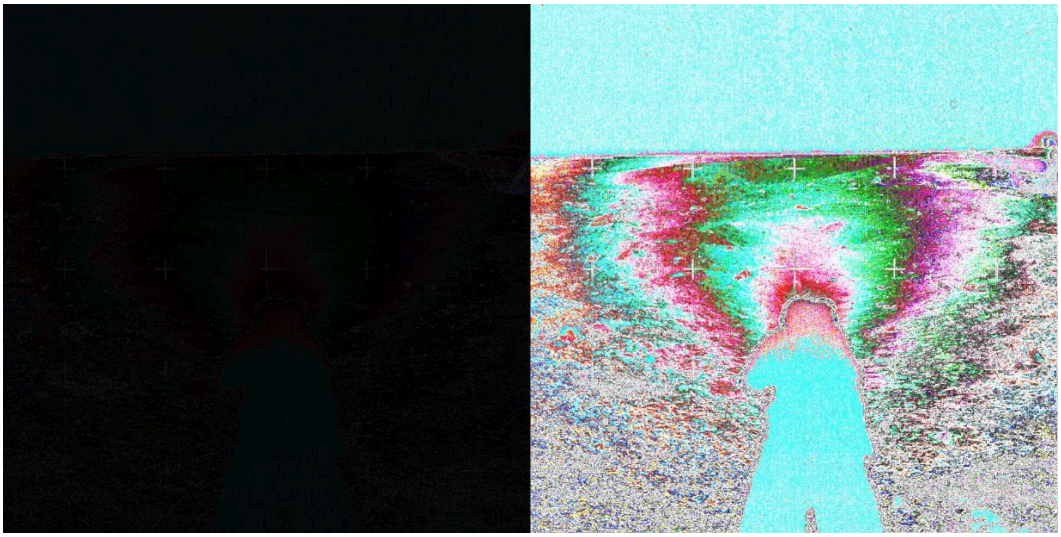


Figure 5. Overlayed difference analysis (left) and the resulting exposed forensic image (right).

Flatten the image or merge both layers to consolidate the difference data. Adjust the **Exposure** to a value of **+12.0** and set the **Gamma Correction** to approximately **0.5**. This process "stretches" the isolated data, amplifying the hidden textures and light patterns to reveal the specific footprint of the image degradation.

4. Forensic Indicators and Analysis

When an expert looks at the results of an IDA process, they are primarily searching for three specific visual cues: hotspots, uniformity, and unexpected grid patterns. These indicators help them decide if the light in the photo follows expectations.

4.1 Hotspots vs. Natural Glare

A hotspot in this type of forensic analysis is a region where the light intensity remains unnaturally even or overexposed after the image has been stressed.

- **Artificial Light Signatures:** Studio lights, flashes, and spotlights are very close to their subjects. They create concentrated zones of light with often with sharp edges.

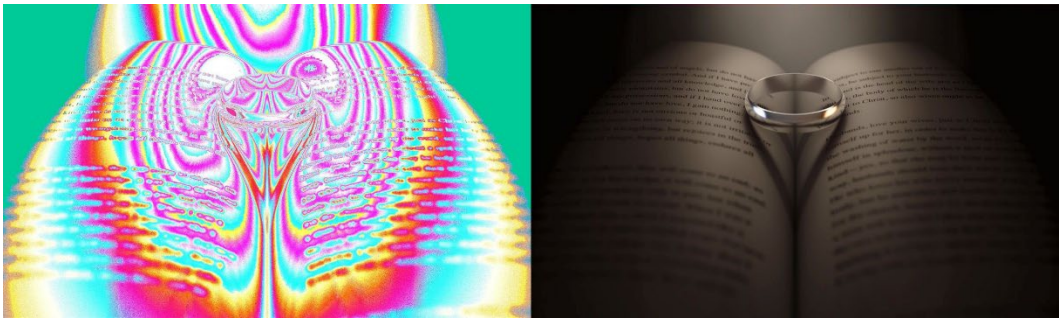


Figure 6. IDA of a localized light focal point on a book

- **Natural Light Signatures:** Sunlight reflecting off surfaces like water, dirt, or pavement behaves very differently. Because the sun is 93 million miles away, its rays are parallel and blends any object in its way. It never creates a hot spot on its own.

Figure 7. Visualizing the physical (non-hotspot) gradient where shadow data is absorbed by even solar distribution

If a photo of the sun appears as a static, saturated circle in an IDA map rather than a turbulent bloom, it suggests the light source was an artificial light or digital FX rather than a star.

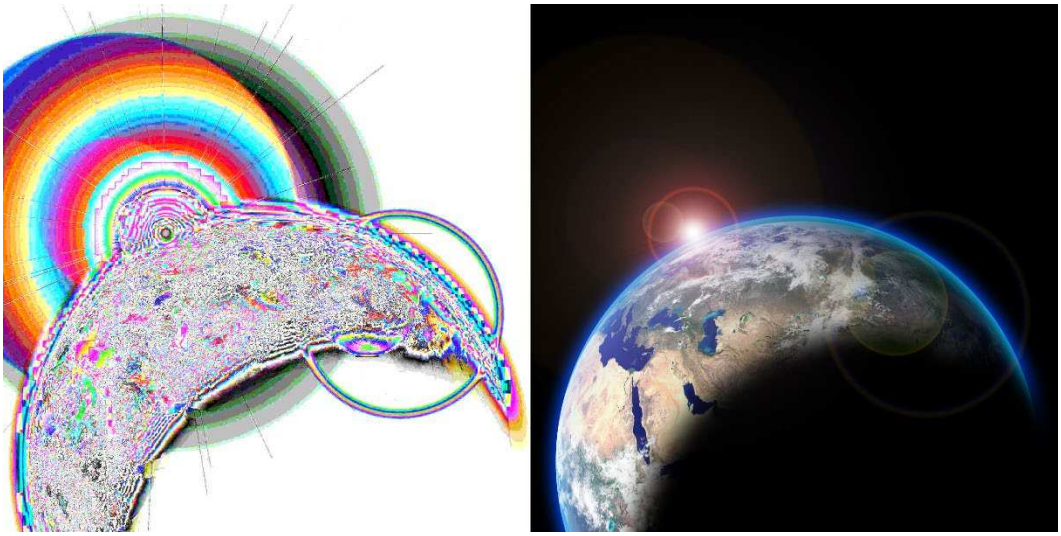


Figure 8. Image Degradation Analysis of a digital FX Earth and Sun

4.2 Compare the above to the real sun

Figure 9. The forensic fingerprint of the Sun

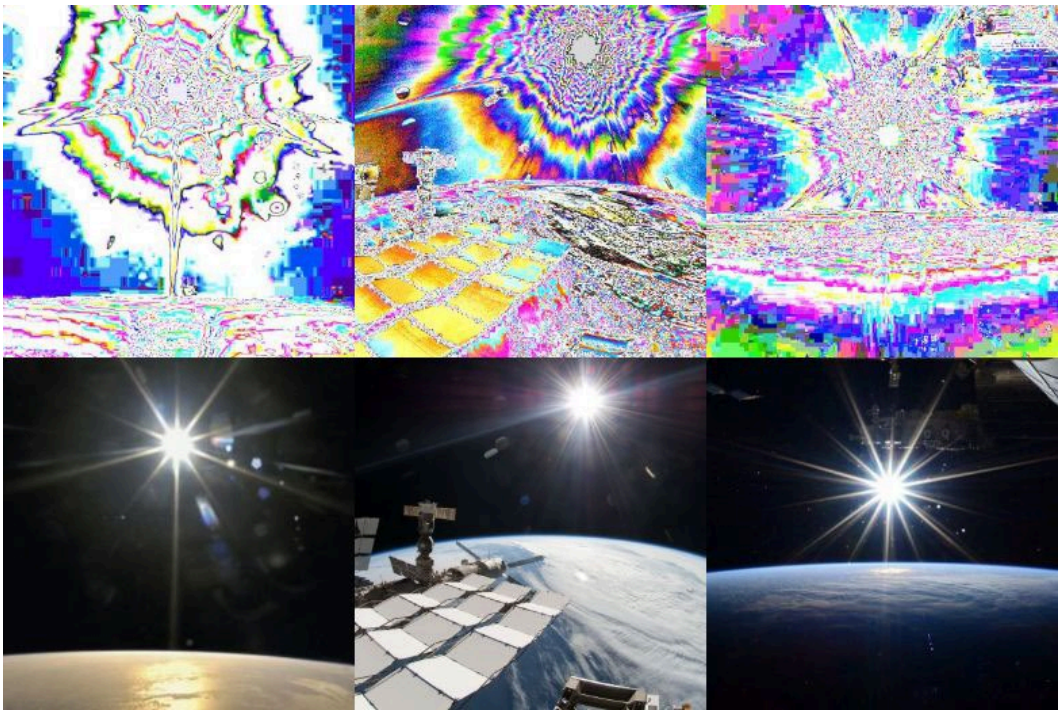


Figure 10. The Sun as seen from the International Space Station (c. 2010s)

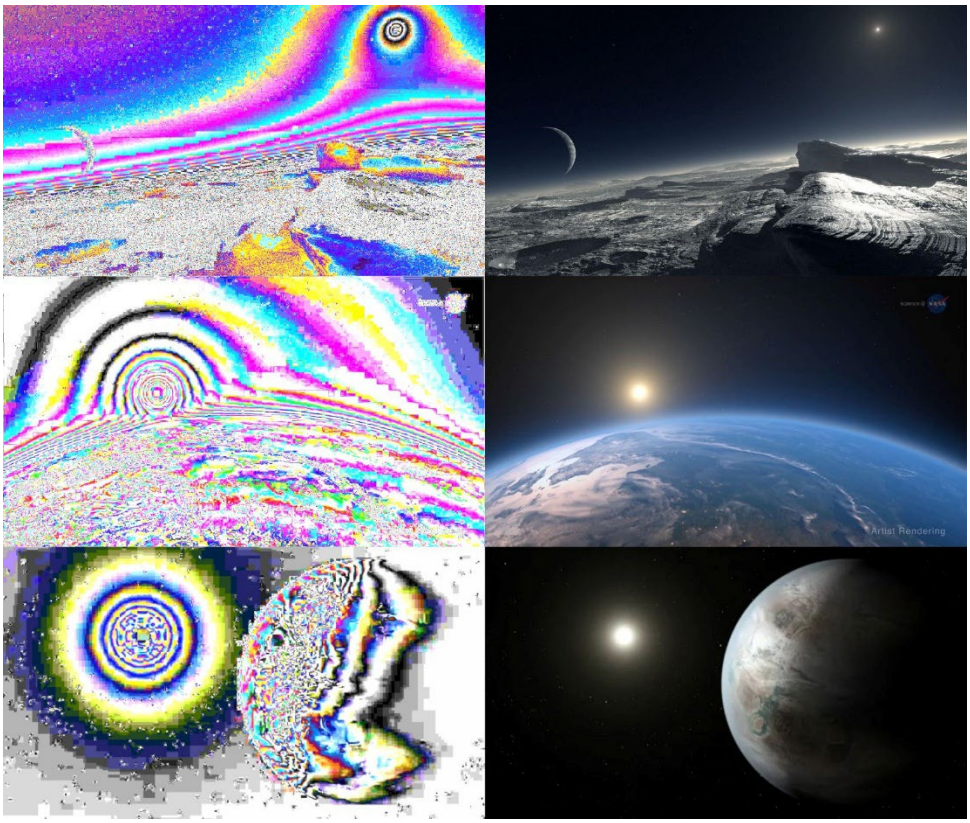


Figure 11. Forensic IDA of solar digital art

5. Case Study: The Apollo Archives

The most famous use of IDA has been to look at the photography from the NASA Apollo missions. This study is interesting because it compares two sets of photos taken with the same equipment but in different locations.

5.1 The Major Difference

When researchers applied IDA to the Apollo archives, they found a clear split in two sets of photographs depicting the sun. Even though the astronauts used the same Hasselblad cameras and film for everything, the sun in the photos looked completely different depending on where they were.

1. **The Orbital Control Group:** These are photos of the sun taken from the spacecraft while in orbit. When these images are put through the IDA process, they show a chaotic and spiky signature. This is exactly what you would expect to see when photographing a massive, turbulent star from space.

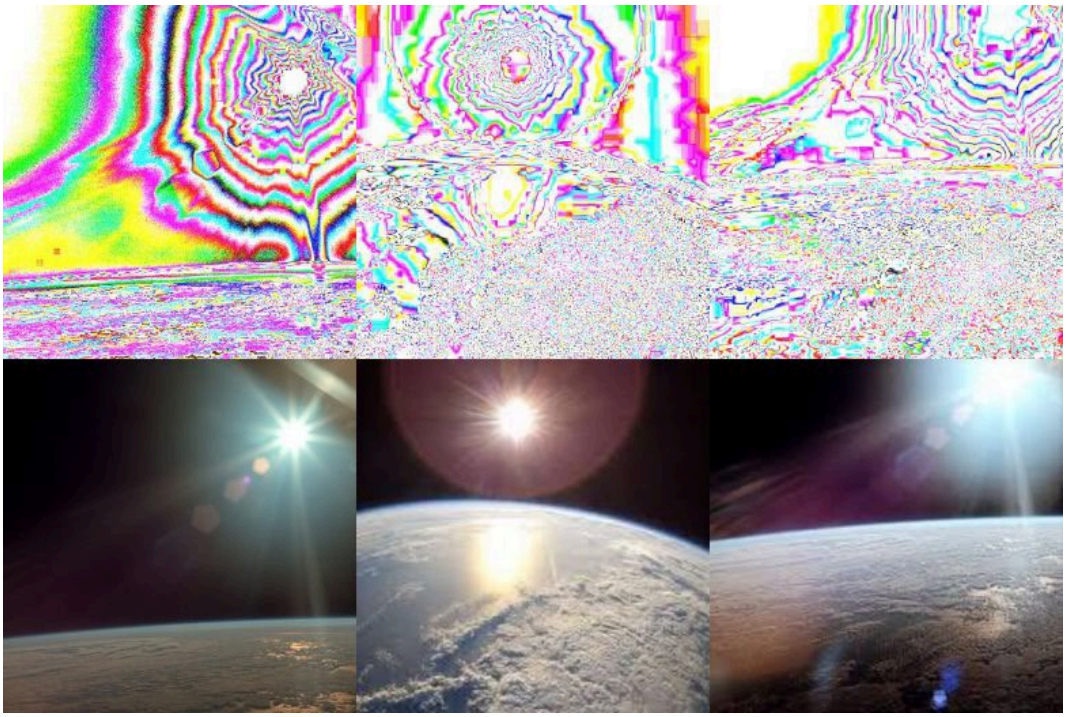


Figure 12. The Sun as seen by Apollo astronauts (c. 1970)

2. **The Lunar Surface Group:** These are photos taken while the astronauts were on the moon. In these images, the sun acts very differently. Instead of a messy starlike shape, it degrades into a uniform, circular "spotlight" pattern.

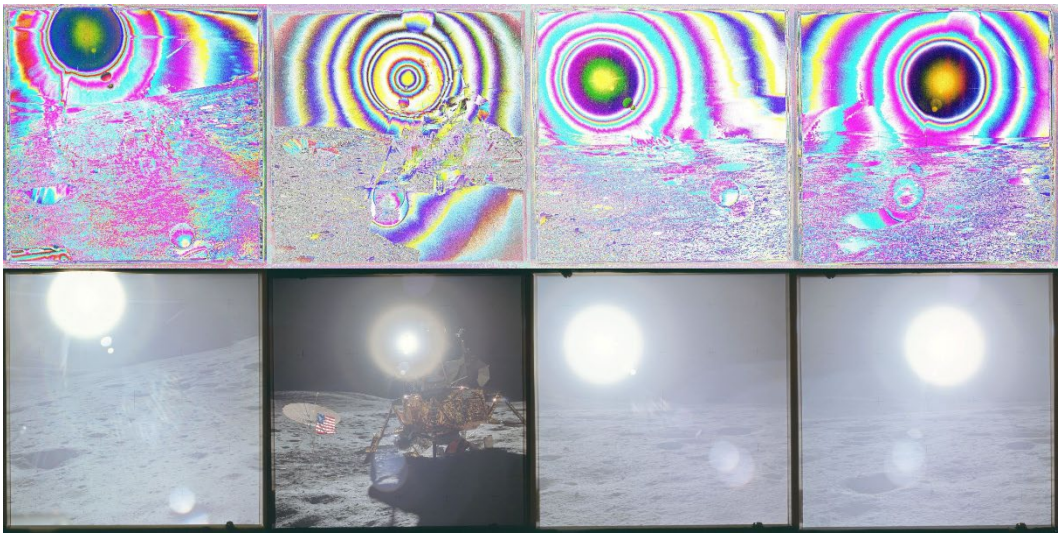


Figure 13. Forensics of the Sun as taken on the Moon during the Apollo missions

5.2 What This Means for Forensics

The fact that the camera hardware stayed the same is the most important part of this analysis. Since the lens and the film did not change, they cannot be blamed for why the sun looks different in the two sets of photos. The light on the lunar surface often shows a "cone of light" effect. This is a bright area that surrounds the subject but does not follow the natural geometry of shadows you would see with parallel sunlight. This suggests that the light source was actually very close to the scene, behaving more like a high-powered studio bulb than a star 93 million miles away.

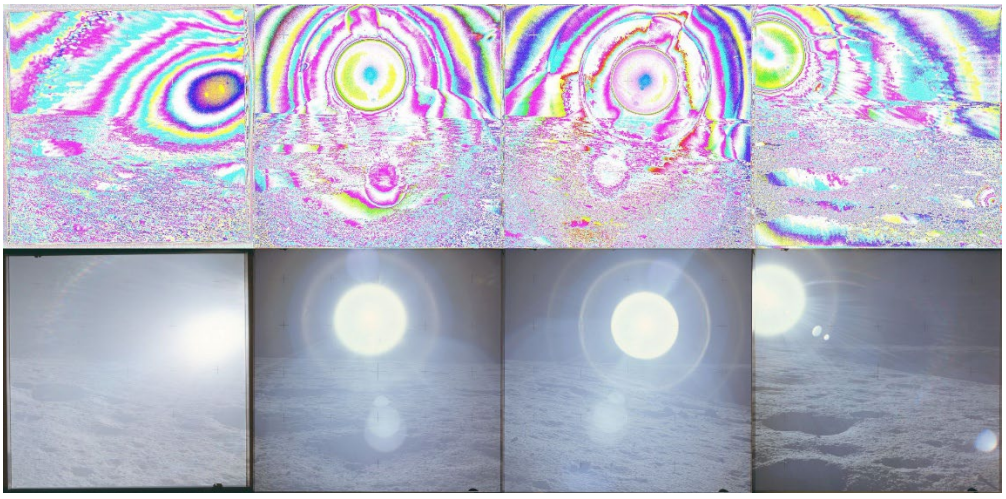


Figure 14. Apollo mission photographs under IDA forensic analysis

5.3 The Curious Case of the Beam of Light

A significant forensic anomaly identified through Image Degradation Analysis (IDA) involves the presence of "hotspots" or localized beams of light in lunar surface imagery that do not align with the known physics of natural sunlight.

Understanding the "Cone of Light" Anomaly

In natural conditions, the sun is positioned approximately 93 million miles from Earth and the Moon. Because of this vast distance, solar rays reach the surface as effectively parallel, spreading intensity evenly across a local scene rather than focusing it into a single spot. It is important to clarify that this diffusion of light is not the same as the diffusion caused by light passing through an atmosphere. On the Moon, the light is already diffused geometrically due to its 93 million mile spread, resulting in a nearly perfect uniform light source over any small local surface. Consequently, the sun does not produce discrete, localized hotspots or concentrated circular "cones of light" on diffuse surfaces like lunar dust.

Forensic analysis of multiple Apollo surface photos reveals concentrated, uniform light sources that behave more like high-intensity spotlights than a distant star. These "hotspots" are characterized by several physical anomalies that defy solar behavior:

1. **Sharp Falloff:** These images show a concentrated zone of brightness that quickly fades into darkness. This is uncharacteristic of parallel solar rays, which distribute intensity evenly across a local area. It is important to remember that the diffusion of light on the Moon is not the same as atmospheric diffusion; because the sun is 93 million miles away, the light is already "diffused" into a massive, uniform spread. A sharp drop-off in brightness suggests the source is only a few feet or yards away.
2. **Geometric Uniformity:** The IDA maps often reveal perfectly circular or oval patterns and "rainbow rings." These geometric signatures indicate a small, proximate light source.
3. **Anomalous Placement:** These spots often appear directly behind subjects or at a focal point in the scene where no localized light source should physically exist.
4. **Absence of Secondary Sources:** The presence of these hotspots cannot be explained by a secondary light source or a powerful camera flash. A secondary source would not be able to overpower the sun to this extent, nor could it be responsible for the primary shadows seen in the images. The hotspots themselves appear to be directly responsible for the shadow geometry.
5. **Frequency and Position:** These hotspots appear hundreds of times throughout the Apollo collections. They are frequently situated right behind the astronaut. This is highly suspicious from a physics standpoint; for the sun to create such a localized effect,

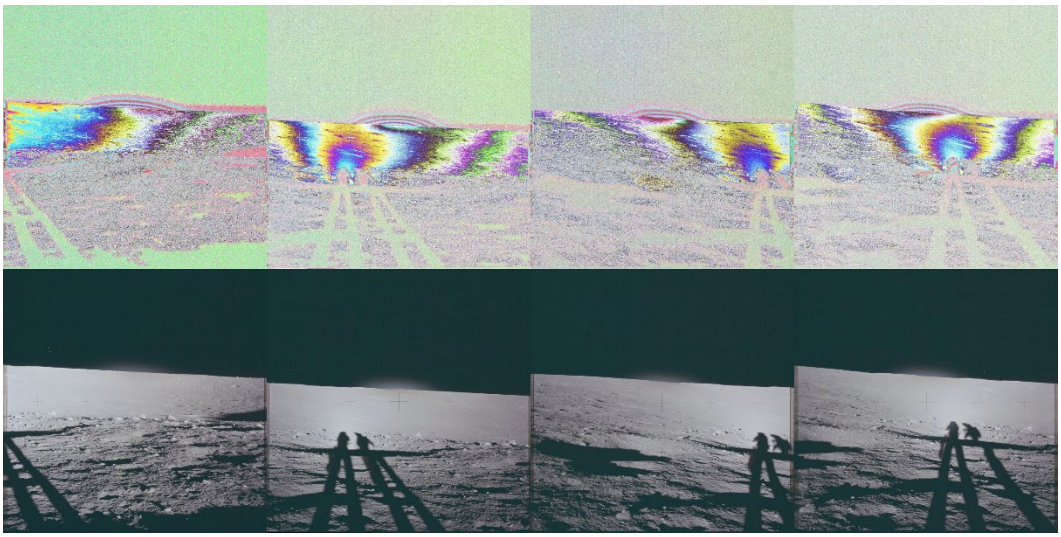


Figure 15. A panoramic view of the anomaly

Ultimately, the presence of these localized beams challenges the fundamental assumption that the Apollo surface photographs were lit exclusively by the sun. If the illumination were truly solar, the vast distance between the light source and the lunar surface would guarantee a uniform, parallel distribution of light, rendering the sharp falloffs and geometric hotspots observed in IDA forensic maps physically impossible. The persistent appearance of these "cones of light" directly behind subjects suggests a controlled environment that is not indicative of the sun.

Comparative Analysis with Control Groups

The significance of this finding is reinforced when compared to control datasets. Images taken in orbit during the same missions using identical Hasselblad camera hardware and film stock show the sun behaving according to physical laws, displaying chaotic coronae, asymmetry, and color dispersion.

The discrepancy between the "orbital sun," which displays natural solar forensics, and the "lunar surface sun," which displays anomalous patterns, under consistent hardware conditions suggests the presence of artificial studio lighting or post-processing compositing in the surface photos.

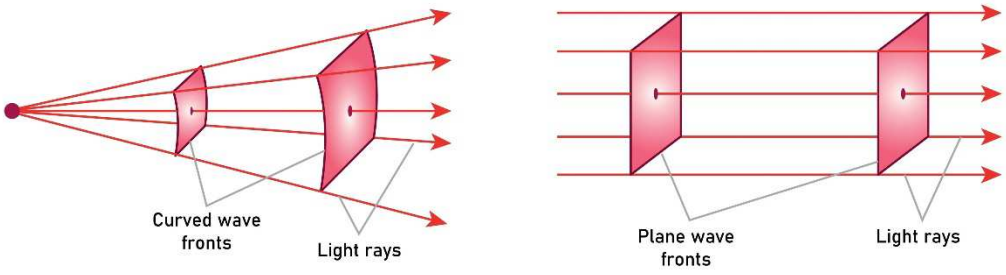
5.4 Forensic Inspection of Specific Photographic Records

The theoretical and forensic frameworks of IDA are best illustrated by examining specific frames within the Apollo archive. Detailed forensic inspection of these records reveals geometric and radiometric signatures that contradict the behavior of parallel solar rays, highlighting inconsistencies that point toward a localized, terrestrial lighting environment.

AS16-108-17627: Point-Source Lighting

In frame AS16-108-17627, the primary forensic indicator is the aggressive decrease in light intensity across a short distance, a phenomenon governed by the Inverse Square Law. Under the physics of a sun 93 million miles away, light intensity is essentially constant across a local scene. However, this photo behaves like a terrestrial "night desert" shoot where the light is concentrated on the central subject and falls off into a deep blackness or significantly lower intensity in the background.

Figure 16. AS16-108-17627



The rapid falloff ($I \propto \frac{1}{r^2}$) suggests the light source is a proximate point-source: a single, high-intensity artificial lamp located only a few dozen feet from the subject. This is further evidenced by "shadow wrapping" around the astronaut and surrounding rocks. Such wrapping is a physical hallmark of a nearby artificial source rather than the sharp, flat lighting produced by perfectly parallel solar rays. It is essential to remember that on the Moon, the light is already diffused *geometrically* due to the 93 million mile spread; a sharp drop-off in brightness within a few meters is physically impossible under solar conditions.

AS17-136-20744: Shadow Convergence

Frame AS17-136-20744 provides striking geometric evidence of an inconsistent light source through the radial projection of shadows. In a solar-lit environment, the immense distance of the sun ensures that all light rays—and therefore all shadows—run parallel.

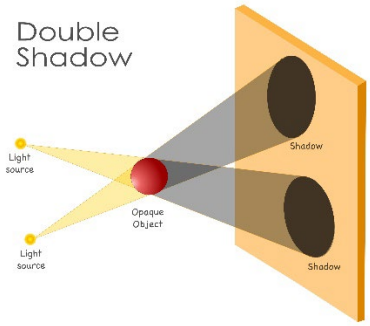
However, the geometric evidence in this frame reveals a physical impossibility:

1. **Converging Shadows:** The shadows cast by the rocks on the far left of the frame move toward the right, while those on the right move toward the left. They converge toward a common center rather than sharing a single, distant vanishing point.
2. **Radial "Fan" Projection:** This "V" or fan-like convergence is a definitive indicator of a proximate point source. It proves the light originates from a source close enough to the scene where the rays diverge radially from a central point, rather than arriving in a parallel wall.
3. **Shadow Angle Inconsistency:** Inspection of individual rock shadows shows they are not cast at the same angle relative to the horizon. This longitudinal shift across the frame is exactly what occurs when a studio spotlight is positioned near the camera.

Figure 17. AS17-136-20744: notice rock shadow upper right side is going left, while rock shadows on the left are going upper right.

Multi-Directional Anomalies and Double Shadows

A frequent point of contention is the presence of shadows that do not share a single vanishing point, even occasionally exhibiting a 90-degree offset. In many instances, a primary shadow is cast forward while a nearby object has a shadow cast at a perpendicular angle. While standard photography might occasionally see complex reflections, the "smoking gun" is the presence of double shadows.



A single sun cannot create two distinct shadows for one object. When these geometric anomalies are paired with IDA forensic analysis, the results are conclusive. The IDA maps show localized hotspot intensities and "rainbow rings" characteristic of nearby lamps precisely where the double shadows originate. This combination—shadows moving in multiple directions and radiometric point-source signatures—confirms the absence of expected solar properties in these surface records.

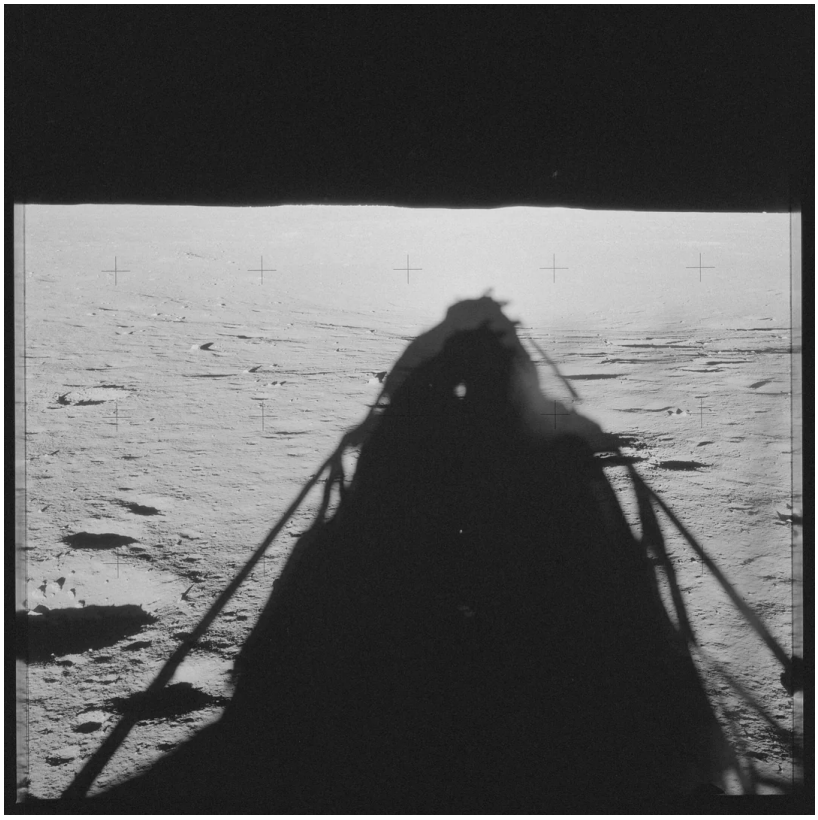


Figure 18. AS12-48-7026 displaying double shadows

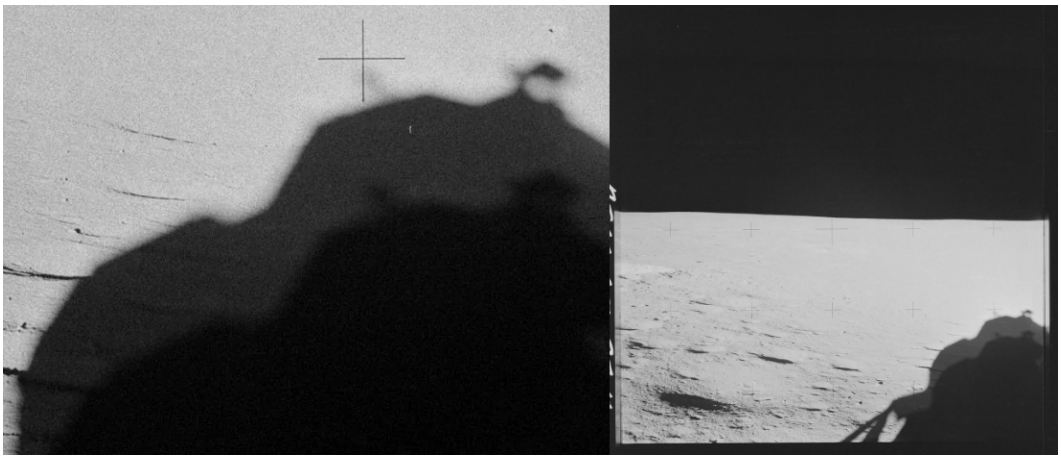


Figure 19. AS14-65-9211 displaying double shadow

Following the case study, this Q&A section addresses common counter-arguments regarding the Moon landing. There will be another Q&A section for IDA after the conclusion.

6. Apollo Mission Q&A

1. If the United States didn't land on the Moon, why didn't Russia expose the fraud?

A: The assumption that Russia remained silent is largely a western narrative. During the Cold War, the American public was conditioned to believe that any dissenting information from the Soviet Union was merely "propaganda." Historically, Russian space experts and officials have expressed significant skepticism; they simply lacked a platform in the West that was considered credible by the public.

2. Didn't Russia recently admit that the USA landed on the Moon?

A: This is a classic example of "headline propaganda." The actual source for this claim states that Russian officials agreed that the soil samples NASA sent to them were indeed lunar in origin. However, confirming that dirt came from the Moon is not the same as confirming a human-crewed landing. The Russian officials maintained their doubts about the human mission itself, but the nuance was lost in the untruthful headlines.

> Lehti, Andrew (2025). Did Russia Admit to the USA landing on the Moon? figshare. Online resource. https://doi.org/10.6084/m9.figshare.30132691

3. If we didn't land, how do we have actual Moon rocks and sand?

A: Soil and rock samples can be retrieved robotically. The Soviet Union's *Luna* missions successfully returned lunar soil to Earth without ever landing a human on the surface. Robotic retrieval was a proven technology during that era and explains the presence of physical samples.

4. We can bounce lasers off the mirrors (retroreflectors) left on the Moon. Doesn't that prove humans were there?

A: No. Retroreflectors do not require a human to place them. The Russians successfully installed retroreflectors on the Moon using their robotic *Luna* missions. The ability to hit a mirror with a laser only proves that a mirror exists, not that a person stood there to put it down.

5. Satellite images from the Lunar Reconnaissance Orbiter (LRO) show the landing sites. Isn't that definitive?

A: The satellite images show six regions with very dark blast or burn marks under the modules. However, in the high-resolution photographs allegedly taken by the astronauts on the surface, there are no such burn marks or blast craters visible under the descent engines. This massive discrepancy suggests that the modules seen from orbit may have been robotically crewed landers—***sent to deploy the reflectors and collect sand***—rather than the human-crewed vessels described in the official narrative. This would explain the track marks from each, as well as the correct scorching below the modules, unlike the undisturbed lunar modules.

6. Do you believe we ever went to space at all?

A: Yes. I believe the astronauts likely took a ride around the Moon (a circumlunar mission). This would explain why Russia was able to track the spacecraft's trajectory and signal, but it does not necessitate that a landing occurred.

Q: Do you know how many people would need to keep this secret?

A: Not as many as you might think. The key to secrecy is compartmentalization. In a covert operation, not everyone in the workforce needs to know the truth. It's enough to make most workers believe the project is a success, while only a handful know what's going on.

Q: Haven't there been people who tried to speak out?

A: Yes, there have already been whistleblowers from NASA who claimed we did not have the technology to reach the moon at that time. While critics often point to studies claiming it would be impossible to keep such a large secret, those very studies use formulas to predict when a leak would occur. In the case of the Apollo missions, leaks did occur in the late 1960s and early 1970s, but they were largely dismissed or ignored by the mainstream narrative.

Q: If the technology didn't exist, how were the photos and videos produced?

A: Image Degradation Analysis (IDA) reveals that many of the surface photos exhibit patterns consistent with artificial studio lighting, such as an abundance of "hotspots" and forensics of the sun which do not match. I can only tell you that the photos are not authentic. Anything else would be merely a guess.

Q: Why do IDA results show a "grid pattern" in some lunar images?

A: After IDA processing, a recurring grid-like structure appears in multiple lunar surface images—a pattern that does not occur in tens of thousands of other analyzed images from Earth or other spaceflight missions. While its origin is still being studied, it is independent of image resolution and persists across repeated processing runs, leading to the hypothesis that it may be a residual artifact from a doctoring process.

Q: Can't the lighting anomalies be explained by the lack of an atmosphere on the moon?

A: No. IDA operates by analyzing pixel-level color relationships directly, so environmental factors like a vacuum are already encoded in the data. Even without an atmosphere, the sun is so far away (93 million miles) that its rays should be effectively parallel and its intensity spread evenly, not concentrated into localized hotspots. The presence of these hotspots strongly indicates proximate, artificial light sources

6. Conclusion

Image Degradation Analysis transforms the concept of "compression loss" from a digital nuisance into a powerful forensic tool. By amplifying the mathematical differences between an original and a degraded signal, IDA exposes the latent physical properties of a scene's illumination that are otherwise invisible to the naked eye. This methodology provides a repeatable, physics-based metric for distinguishing between the chaotic, parallel energy of the natural world and the ordered, localized uniformity of artificial lighting.

The application of this framework to the Apollo mission case study has opened new doors in my own understanding of these historical records. To be candid, this investigation fundamentally changed my perspective on the Apollo moon landings. Before I began investigating the archive using IDA, my original intent was to mathematically disprove conspiracy theorists and validate the official record. However, the consistent forensic anomalies (the hotspots, converging shadows, 90-degree shadows, double shadows, grid-patterns, and forensic sun fingerprint mismatches) have led me to a different realization. I now understand that these skeptics were not "crazy," but rather **that I was too indoctrinated** by a lifetime of accepted narrative to truly listen or look at the data objectively.

Ultimately, IDA serves as an impartial "judge" of light physics **occasionally**. Whether applied to historical archives or modern digital forgeries, it ensures that even when the visual surface of a photograph is smooth and convincing, the underlying mathematical skeleton of the light remains available for inspection. By prioritizing the immutable laws of radiative transfer over the integrity of a deceptive pixel surface, we can determine with scientific certainty whether a captured moment truly occurred within the physical environment it claims to depict.

Image Degradation Analysis Q and A

Q: Can you explain the methodology behind "PEM-Image Analysis" or "Image Degradation Analysis" in layman's terms?

A: The methodology, originally termed **Photoelectromagnetic (PEM) Image** Analysis, has been re-designated as **Image Degradation Analysis** to mitigate semantic confusion. Fundamentally, this process functions similarly to **Error Level Analysis (ELA)**. By significantly increasing exposure, altering gamma, and degrading the image, we can isolate and evaluate how light is absorbed, reflected, and refracted within the frame.

1. Find the image.
2. Degrade the image with JPEG down to quality: 5%.
3. Place the degraded image over the original and find the difference.
4. Raise the exposure accordingly, which you can find here: https://andylehti.github.io/ida-forensics/

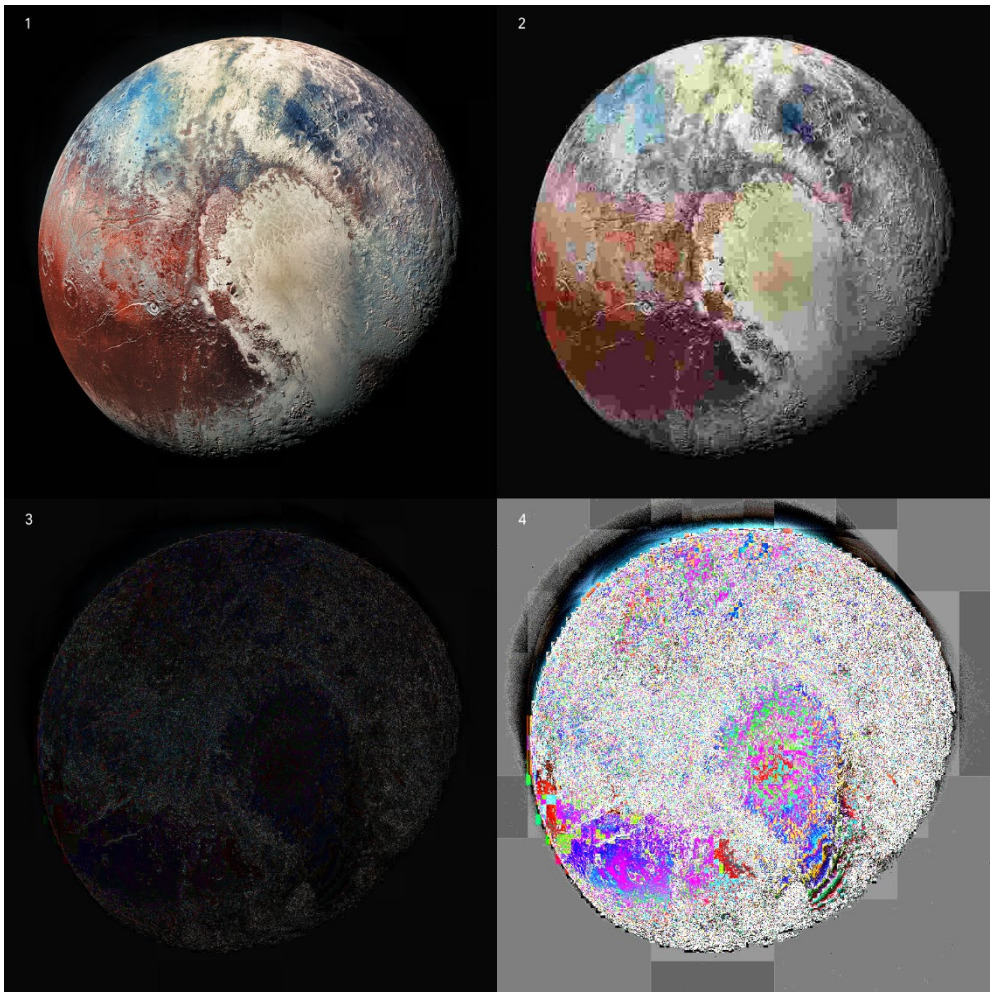


Figure 20. Image Degradation Analysis (IDA) workflow.

Q: What is the objective of IDA?

A: The objective is to identify inconsistencies in light source characteristics. When applied to official Apollo archive photos, the "sun" depicted in surface images does not exhibit the same degradation properties—such as turbulence, spiky patterns, and specific color spectrum shifts—that are present in genuine photos of the sun taken from orbit or Earth. Instead, the lunar surface "sun" degrades into patterns consistent with artificial light sources, specifically light bulbs.

Q: What about geometric patterns?

A: Illumination produces geometric energy distributions across surfaces. Intensity decreases with distance (inverse-square law), and different wavelengths are absorbed at different rates. These physical interactions create structured radial and directional gradients that are often too subtle for the naked eye to perceive due to visual diffusion.

Q: Critics argue that comparing different images is scientifically invalid because they were shot with different lenses, sensors, and film stock. How do you address this variable?

A: While it is true that lens elements and sensor sizes introduce artifacts and noise, the core premise of this analysis is that **"color is color."** The degradation process breaks the image down into its fundamental like-colors.

The lighting variables of a studio are naturally inconsistent, whereas natural sunlight provides a consistent baseline. The analysis demonstrates that the light source in the Apollo surface photos lacks the inherent properties of the sun found in control groups (orbital photos used with similar equipment), suggesting the presence of artificial lighting or digital editing—specifically, that NASA edited a "fake sun" over the original source.

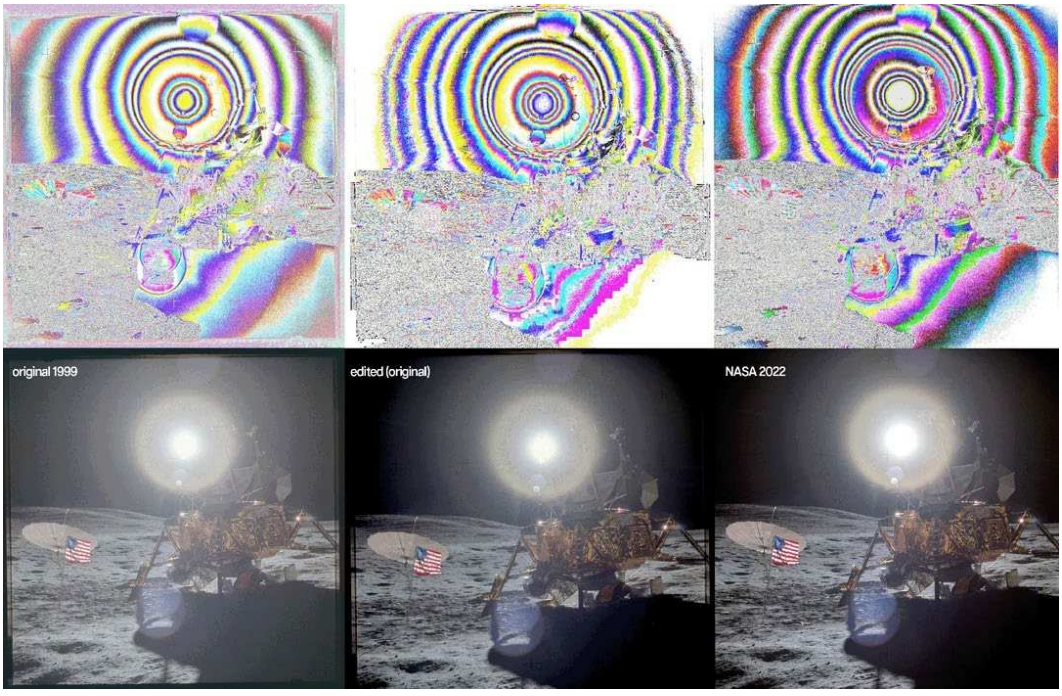


Figure 21. Side-by-side comparison of the 1999 original image, an edited derivative of the original, and the NASA 2022 release

Q: What is Image Degradation Analysis (IDA), formerly PEM-Image Analysis?

A: Image Degradation Analysis is a forensic image comparison technique that highlights inconsistencies in digital images by intentionally degrading a copy of the original and measuring the differences. Originally named Photoelectromagnetic Image Analysis (PEM-Image), it was renamed to avoid confusion, as the term "photoelectromagnetic" refers more to color and light interaction than the method itself.

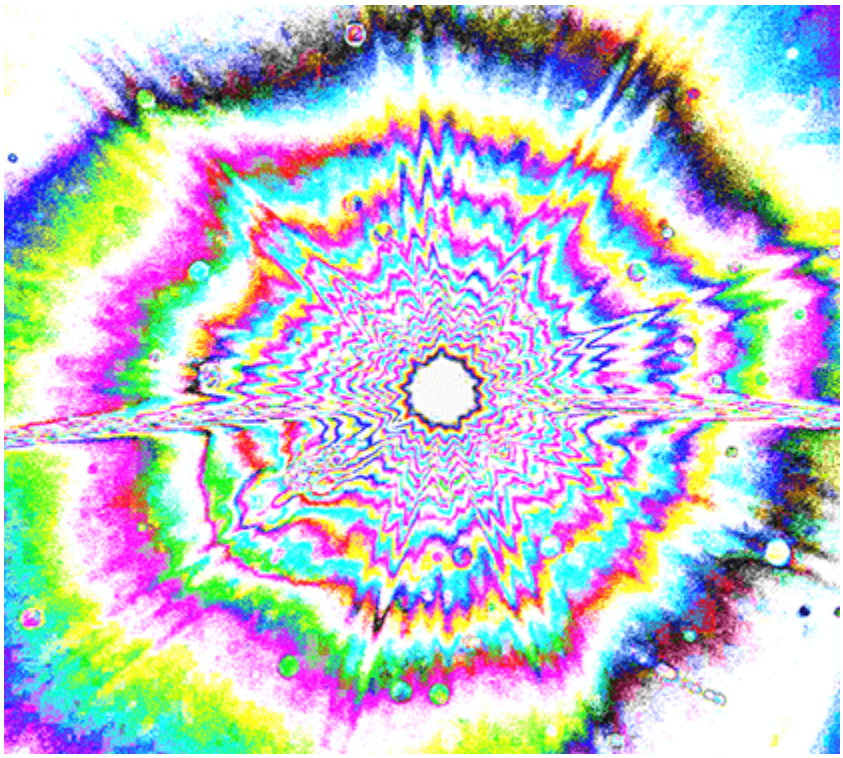


Figure 22. The sun typically appears with a white core, spiked bloom, and CYMK hues near the center. While the atmosphere causes negligible variations, significant changes occur during sunrise, sunset, and cloud interference due to light bending.

Q: How does the technique work?

A: The method involves saving a copy of an image in very low JPEG quality (e.g., 5 out of 100), then comparing it to the original. The difference between the degraded and original versions is extracted, typically by increasing exposure and adjusting gamma to highlight variations. This process is similar in principle to Error Level Analysis (ELA), but is more extreme and specifically designed to reveal anomalies in light patterns, artifacts, or edits that may not be visible otherwise.

Q: How does this relate to Error Level Analysis (ELA)?

A: ELA detects inconsistencies in compression, often to reveal spliced elements. IDA is a derivative of this, extending the principle with greater degradation, broader color channel comparisons, and intensity mapping. ELA typically looks for local edits, while IDA seeks global lighting irregularities, such as simulated sunlight.

Figure 23. Original Image vs. Error Level Analysis vs. Image Degradation Analysis

Q: What does degrading an image tell us?

A: When an image is saved at low quality, compression artifacts and inconsistencies emerge, especially around areas of high detail or artificial manipulation. By comparing this degraded image to the original, researchers can isolate these anomalies. Consistent light sources (like the sun) tend to degrade in predictable ways, while artificial or edited sources may not.

Figure 24. Alternative version of Pluto. This version makes it easier to spot the original boundary in the image; details that might have otherwise gone unnoticed.

Q: What did Image Degradation Analysis reveal about NASA's moon photos?

A: The analysis showed that photos taken during the Apollo missions which included the sun displayed characteristics unlike the sun in other images from orbit or from Earth. Specifically, the sun in the lunar surface photos appeared uniform, overly circular, or oval with color distortions, unlike the turbulent, irregular light signature seen in genuine sun images. However, other Apollo photos taken in orbit using the same camera setup did display proper sun characteristics. This discrepancy led to the hypothesis that the lunar photos may have used artificial lighting, indicating fraud.

Q: Why was JPEG quality = 5% selected? What happens at other levels?

A: A compression level of 5% was selected because it produces the most consistent amplification of illumination structure while preserving sufficient image coherence for comparison. Other compression levels between 1% and 6% also produce usable outputs but generate systematically different artifact structures. These are treated as methodological variants rather than interchangeable settings. To standardize reporting, compression–exposure combinations are encoded as procedural identifiers. For example:

- IDA15 ⟶ 1% compression with exposure level 5
- IDA25 ⟶ 2% compression with exposure level 5
- IDA55 ⟶ 5% compression with exposure level 5 (standard protocol)

Any deviation from the standard configuration must be explicitly labeled.

Q: Are laboratory simulations performed under identical camera conditions?

A: Yes. Controlled imaging experiments compare artificial and natural light sources under identical camera settings.

Observed differences are hypothesized to arise from variations in radiative power, penetration, and wavelength-dependent absorption. Different light sources interact with surface pigments differently, producing distinct spectral redistribution patterns. Natural sunlight consistently produces a characteristic radial distribution across color channels, whereas artificial sources produce alternative distributions.

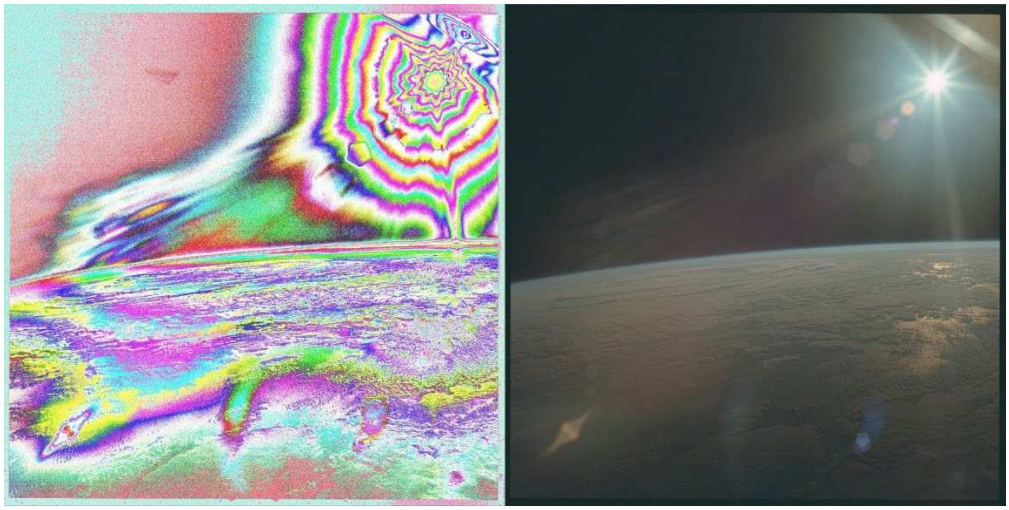


Figure 25. The Apollo 11 sun, under forensic analysis the sun as taken from the Apollo 11 camera demonstrates all the expected characteristics of the forensics of the sun.

Q: Does capture medium (digital vs scanned vs analog) matter?

A: No. The analysis operates on pixel color relationships present in the image data itself. Regardless of acquisition pathway—*digital capture, film scanning, or analog video transfer*—the encoded spatial color structure remains analyzable once digitized.

Q: What software or tools are used?

A: The process uses the Python Imaging Library (PIL), FFMPEG for video frame extraction, and custom scripts available on GitHub (https://github.com/andylehti/pemi). A couple different web versions are also available at https://pemimage.streamlit.app for those who want to test it themselves, and another variation using JavaScript at https://andylehti.github.io/ida-forensics/

Q: What are hotspots in Image Degradation Analysis?

A: In IDA, hotspots refer to regions of an image where light intensity remains unnaturally uniform or overexposed after degradation. These regions often lack the usual light diffusion or turbulence expected from natural light sources such as the sun. The detection of hotspots can indicate artificial lighting, image manipulation, or compositional inconsistencies.

Figure 26. Anomalies in the moon landing photo. Hot spots appear behind the astronaut where there should be no hot spots.

Q: How does IDA measure light intensity?

A: IDA doesn't directly measure lumens but reveals relative intensity patterns. By exaggerating compression artifacts and analyzing the degree of pixel loss across the spectrum, the method can approximate where light was strongest or most uniform. Stronger artificial lights tend to produce harsh, sharply defined center zones, whereas natural light degrades more gradually

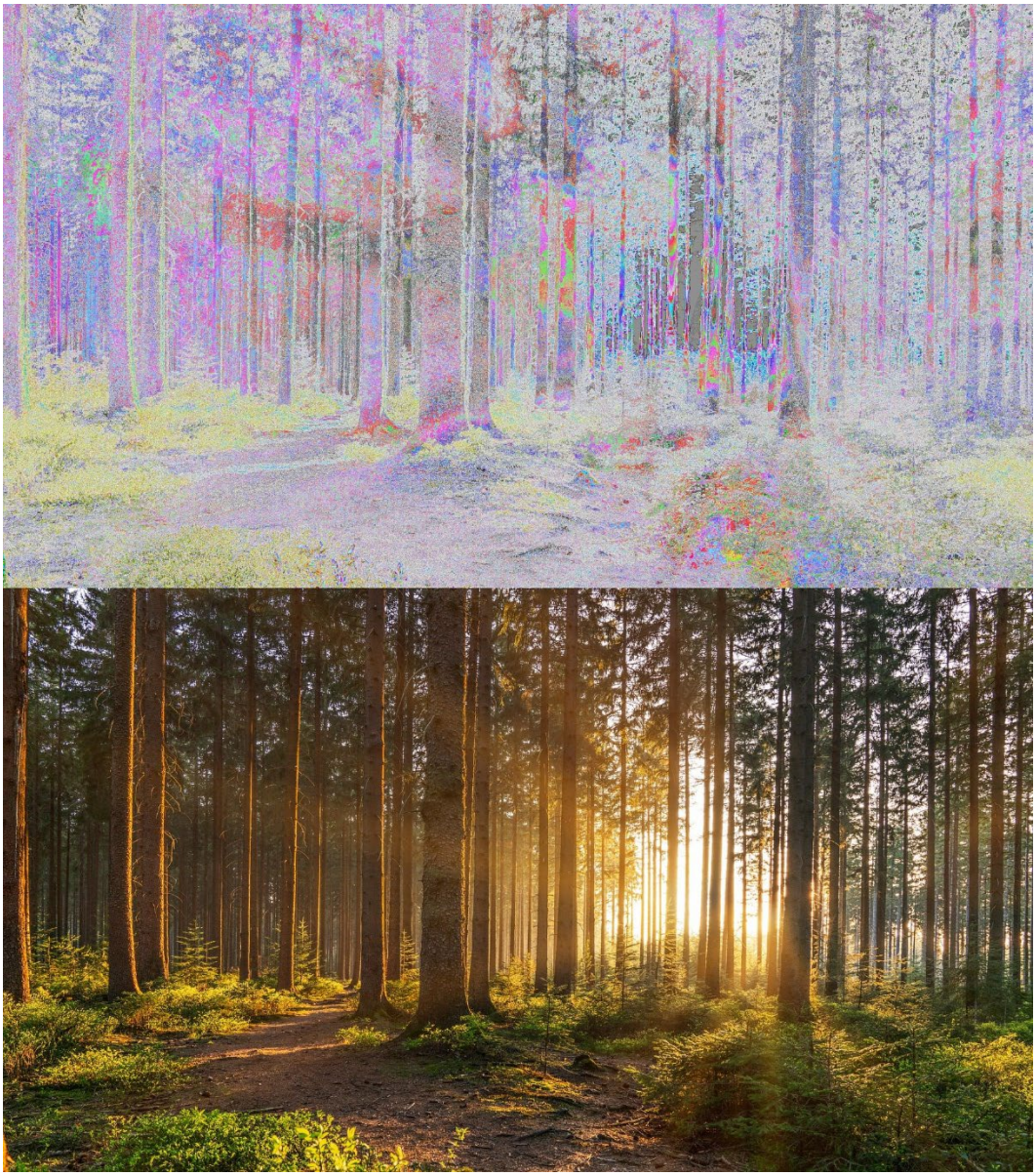


Figure 27. Examples of natural light under IDA.

Q: Why is light behavior important in authenticity analysis?

A: Light follows physical laws. Under compression and exposure manipulation, natural sources (like the sun) scatter and blend in a mathematically complex but predictable way. Artificial lights often fail to replicate this, showing uniformity, lack of flare artifacts, and geometrically perfect shapes relative to natural light. This discrepancy is central to IDA's ability to detect deception or post-processing.

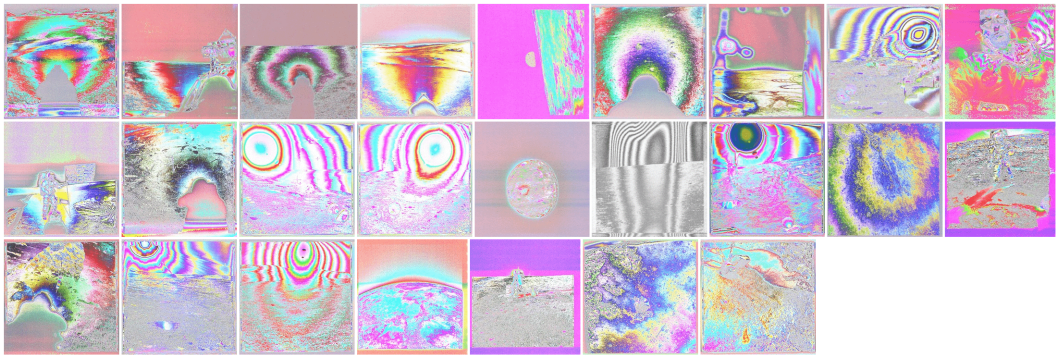


Figure 28. Anomalies in the Moon Landing photosets may indicate unnatural lighting.

Q: What role do camera types and optics play in this?

A: While different sensors and lenses create different optical effects, IDA accounts for this by only comparing within consistent hardware contexts. For example, Apollo images taken with the same Hasselblad lens and film stock both on the moon and in orbit are directly compared. If the sun looks realistic in orbit but anomalous on the lunar surface with the same hardware, **that's a red flag.**

Q: What if the light anomaly is just natural glare, like reflections off water or pavement?

A: Natural glare—such as sunlight reflecting off water, polished stone, or parking lot asphalt—does occur, but it still follows the physical behavior of diffusion and angle-dependent scatter. In Image Degradation Analysis (IDA), these reflections do not form persistent overexposed hotspots. They fluctuate based on texture, reflectivity, and viewing angle, and degrade with turbulence and asymmetry. Artificial lighting or compositing, on the other hand, often produces static hotspots with no such environmental variability.

Figure 29. Pavement with relative heat spot shows very subtle change under forensics

Q: Why doesn't the sun produce hotspots even though it is extremely bright?

A: Because of its vast distance (approximately 93 million miles), the sun functions as a nearly perfect uniform light source over any small local surface. Its rays are effectively parallel, and its intensity is spread evenly across most surfaces it illuminates. As a result, the sun does **not** produce localized hotspots in photos—especially not discrete, high-saturation circles or ovals. Instead, it creates global lighting with shadows and diffuse highlights, unless a specular surface (like metal or glass) reflects it directly.

Figure 30. Diffusion of the sun under IDA.

Q: What causes a heat spot or hot spot?

A: Only localized, high-intensity light sources that do not follow parallel uniform diffusion patterns create true heatspots in imagery. These include studio spotlights, vehicle headlights, flashbulbs, and artificial backdrops. Unlike the sun, these sources can create distinct concentrated zones of brightness with sharp falloff, saturation clipping, and chromatic uniformity. IDA exposes this by revealing those unnatural gradients and boundary artifacts.

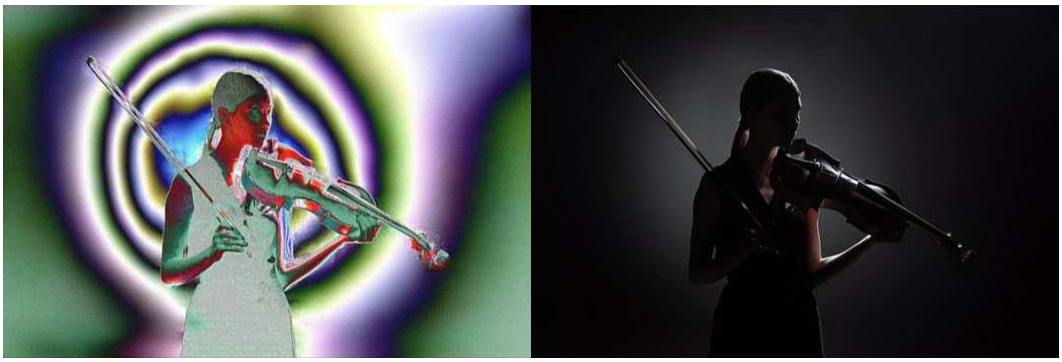


Figure 31. Example of a high intensity heat spot under IDA

Q: Can glare or reflection ever look like a hotspot under IDA?

A: Rarely, and when it does, the IDA pattern still retains telltale signs of environmental interaction—parallel shapes, or similar color spectra. Hotspots created by artificial lighting often are exaggerated by their environment.

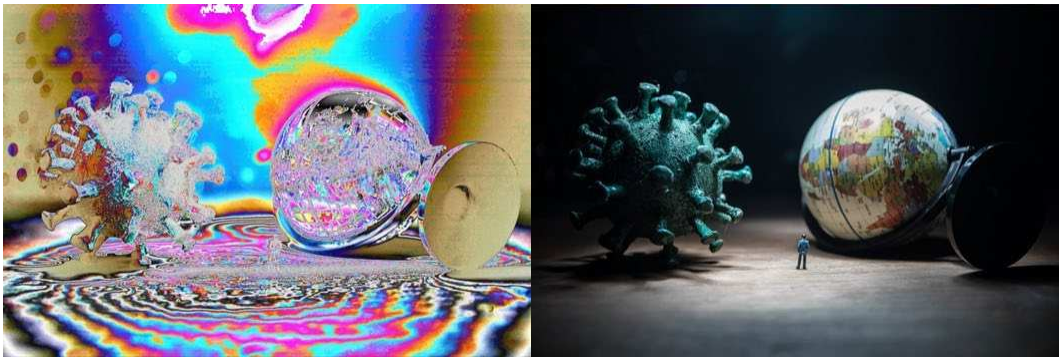


Figure 32. Another example of a circular heat spot on the ground's surface.

Q: How does this relate to the Moon landing images?

A: When IDA is applied to photos from the Apollo missions, certain images allegedly taken on the Moon show concentrated, uniform "sun" sources that behave more like spotlights than like the real sun. In contrast, images taken in orbit with the same camera hardware show light behavior consistent with natural sunlight—chaotic coronae, asymmetry, and color dispersion. This discrepancy, especially the appearance of uniform hotspots on a dust-covered surface, contradicts expected solar behavior and points to possible artificial lighting.

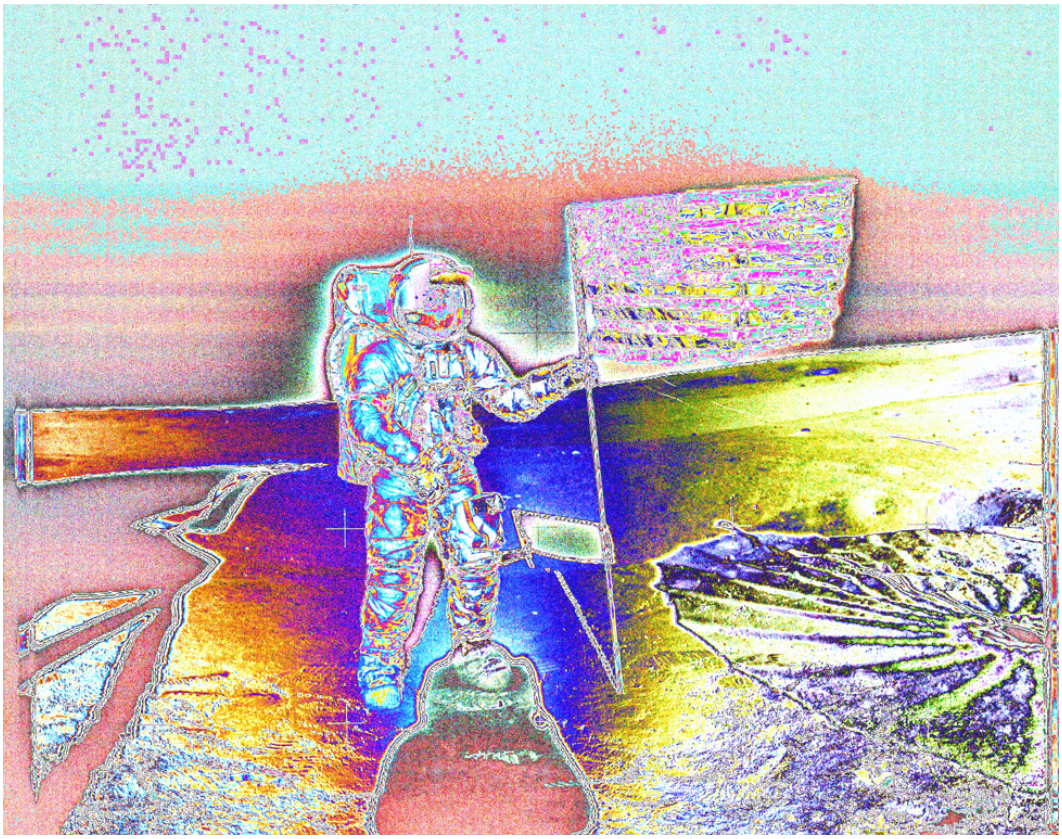


Figure 33. Heat spot uncharacteristic of the sun in a photo of the Moon Landing.

Q: What makes this different from traditional Error Level Analysis (ELA)?

A: ELA detects compression differences to identify edited regions but usually focuses on detecting single edited areas. IDA (PEMI) intensifies the process by using severe degradation, uniform exposure adjustments, and direct overlays, which allows broader insight into image uniformity, lighting sources, and visual behavior across datasets.

Q: How does IDA account for vacuum conditions?

A: Environmental modeling is not required. The method analyzes pixel-level color relationships directly. Any environmental influence that alters illumination distribution is already encoded in those pixel relationships and therefore appears in the analysis.

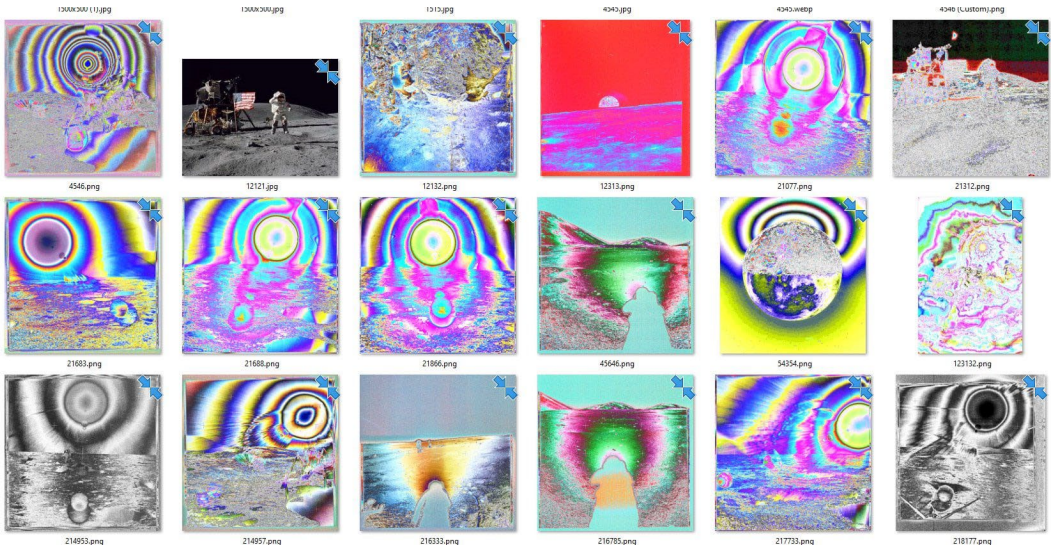


Figure 34. Heat spots and lighting changes in the same dataset raise serious concerns about authenticity.

Q: Has the method been validated or accepted in formal circles?

A: Not yet. The method was developed independently over four years by Andrew Lehti and is still in an experimental phase. Critics argue it lacks formal controls, while supporters say it provides compelling evidence when used comparatively across large image datasets.

Q: Why should compression artifacts encode information about light source physics rather than only compression behavior?

A: JPEG compression reduces image information by merging pixels with similar color and luminance values. As compression increases, neighboring pixel values are progressively averaged into shared representations. This process effectively reveals the underlying spatial organization of color gradients and intensity transitions that were originally produced by illumination geometry.

Because light interacting with a scene produces structured gradients—*determined by direction, intensity falloff, reflectance, and spectral absorption*—these gradients form consistent spatial relationships between neighboring pixels. When compression forces those relationships to collapse toward shared values, the geometric structure of illumination becomes more pronounced.

In practical terms, the degradation process amplifies the spatial continuity of light distribution. This allows reconstruction of illumination geometry, including directionality, falloff patterns, and spectral response behavior. The method does not introduce new information; rather, it exposes latent structure already encoded in pixel relationships by exaggerating how those relationships collapse under compression.

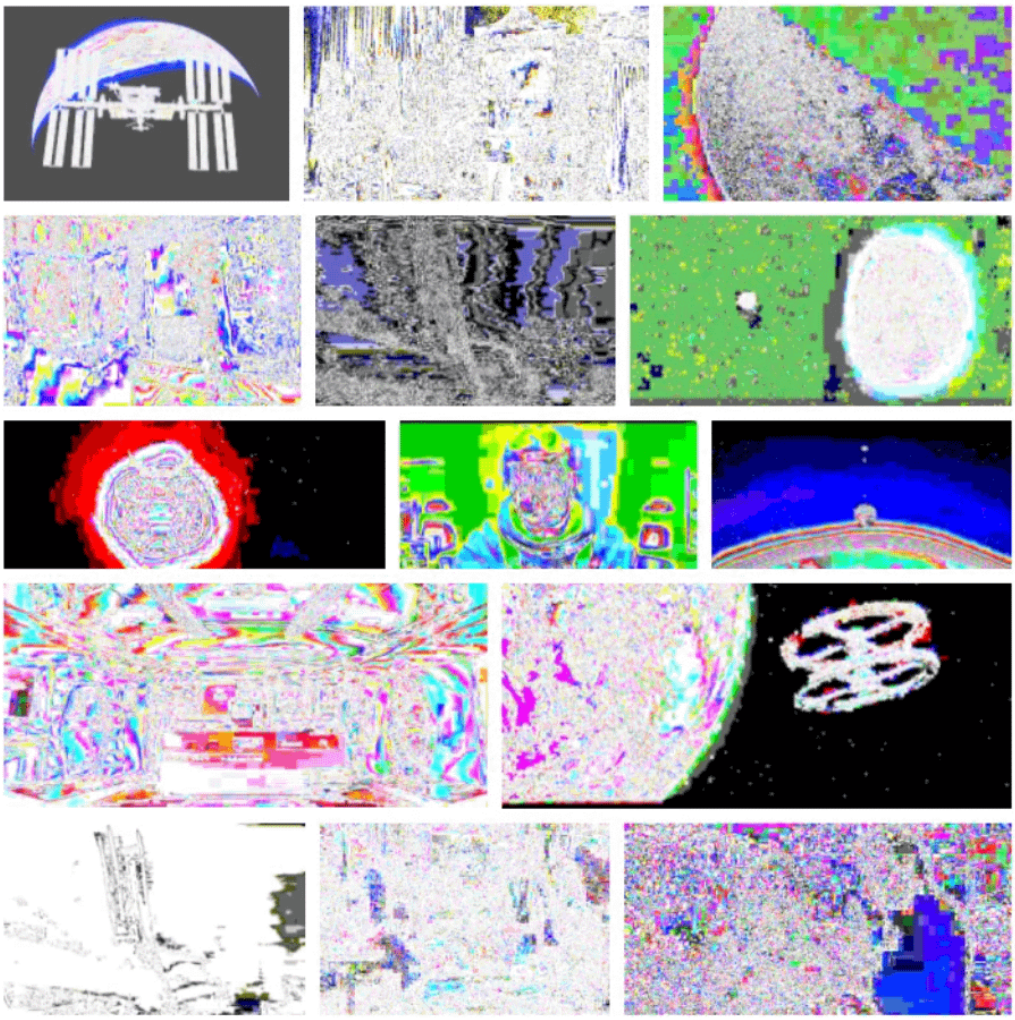


Figure 35. Analyses of 2001: a Space Odyssey

Q: What are common criticisms of IDA/PEMI?

A: Critics say it's just showing JPEG artifacts, that analog photos aren't suitable for digital degradation comparison, and that camera differences explain discrepancies. The response to this is that comparisons are made within similar datasets (same cameras, same mission rolls), and that the method focuses on color behavior and light diffusion patterns that remain consistent across mediums

Q: Do results remain stable across technical variations?

A: Results remain stable when:

- different software libraries are used
- images are resaved multiple times
- different compression formats (*JPEG, WebP, HEIC*) are used

The structural illumination patterns remain consistent.

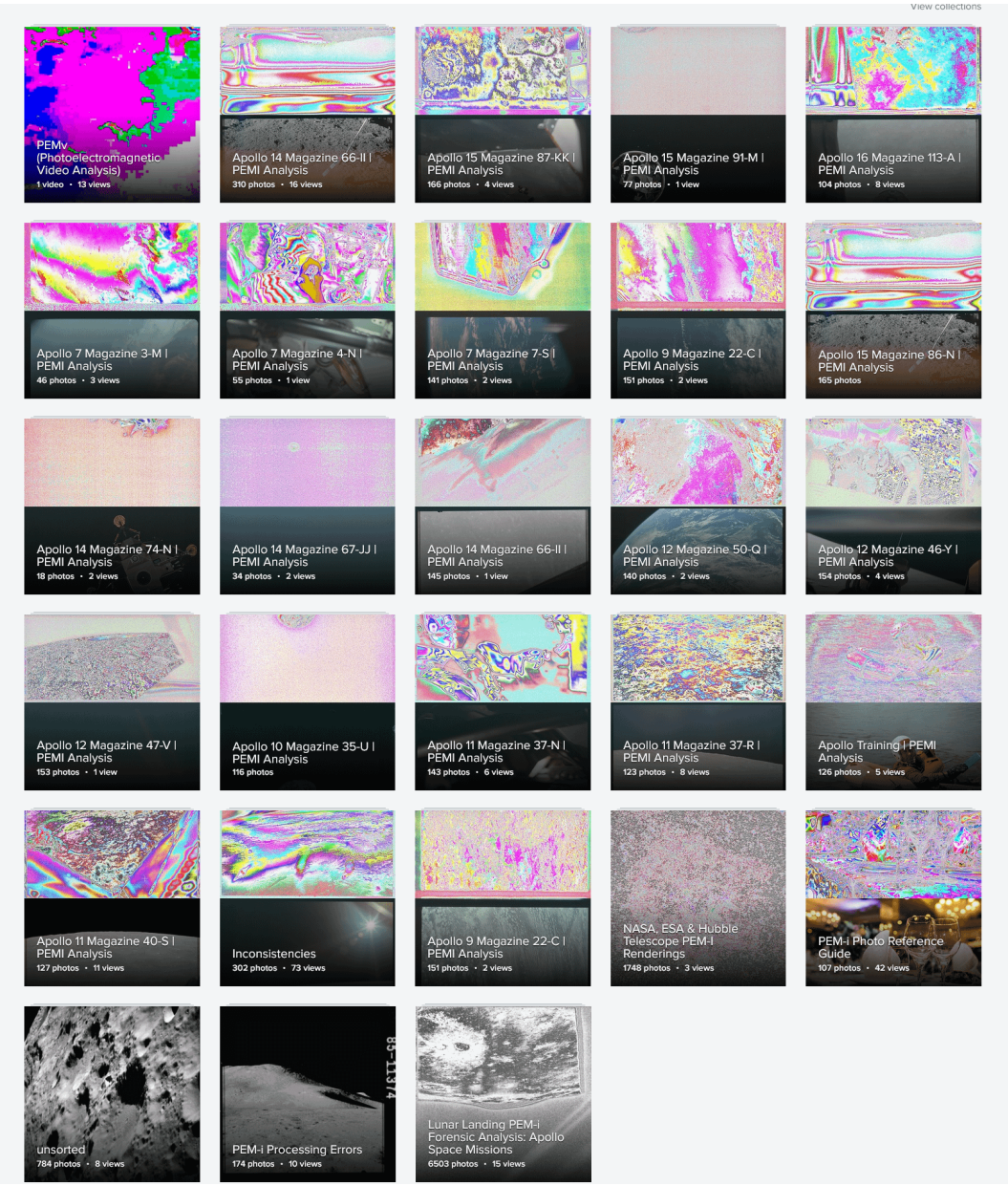

View collections
PEMv (Photoelectromagnetic Video Analysis)
1 video • 13 views
Apollo 14 Magazine 66-II | PEMI Analysis
310 photos • 16 views
Apollo 15 Magazine 87-KK | PEMI Analysis
166 photos • 4 views
Apollo 15 Magazine 91-M | PEMI Analysis
77 photos • 1 view
Apollo 16 Magazine 113-A | PEMI Analysis
104 photos • 8 views
Apollo 7 Magazine 3-M | PEMI Analysis
46 photos • 3 views
Apollo 7 Magazine 4-N | PEMI Analysis
55 photos • 1 view
Apollo 7 Magazine 7-S | PEMI Analysis
141 photos • 2 views
Apollo 9 Magazine 22-C | PEMI Analysis
151 photos • 2 views
Apollo 15 Magazine 86-N | PEMI Analysis
165 photos
Apollo 14 Magazine 74-N | PEMI Analysis
18 photos • 2 views
Apollo 14 Magazine 67-JJ | PEMI Analysis
34 photos • 2 views
Apollo 14 Magazine 66-II | PEMI Analysis
145 photos • 1 view
Apollo 12 Magazine 50-Q | PEMI Analysis
140 photos • 2 views
Apollo 12 Magazine 46-Y | PEMI Analysis
154 photos • 4 views
Apollo 12 Magazine 47-V | PEMI Analysis
153 photos • 1 view
Apollo 10 Magazine 35-U | PEMI Analysis
116 photos
Apollo 11 Magazine 37-N | PEMI Analysis
143 photos • 6 views
Apollo 11 Magazine 37-R | PEMI Analysis
123 photos • 8 views
Apollo Training | PEMI Analysis
126 photos • 5 views
Apollo 11 Magazine 40-S | PEMI Analysis
127 photos • 11 views
Inconsistencies
302 photos • 73 views
Apollo 9 Magazine 22-C | PEMI Analysis
151 photos • 2 views
NASA, ESA & Hubble Telescope PEM-I Renderings
1748 photos • 3 views
PEM-I Photo Reference Guide
107 photos • 42 views
unsorted
784 photos • 8 views
PEM-i Processing Errors
174 photos • 10 views
Lunar Landing PEM-i Forensic Analysis: Apollo Space Missions
6503 photos • 15 views

Figure 36. Albums of photosets: https://www.flickr.com/photos/gitresearch/albums/with/72177720307838826

Q: What are hotspots in Image Degradation Analysis?

A: In IDA, hotspots refer to regions of an image where light intensity remains unnaturally uniform or overexposed after degradation. These regions often lack the usual light diffusion or turbulence expected from natural light sources such as the sun. The detection of hotspots can indicate artificial lighting, image manipulation, or compositional inconsistencies.

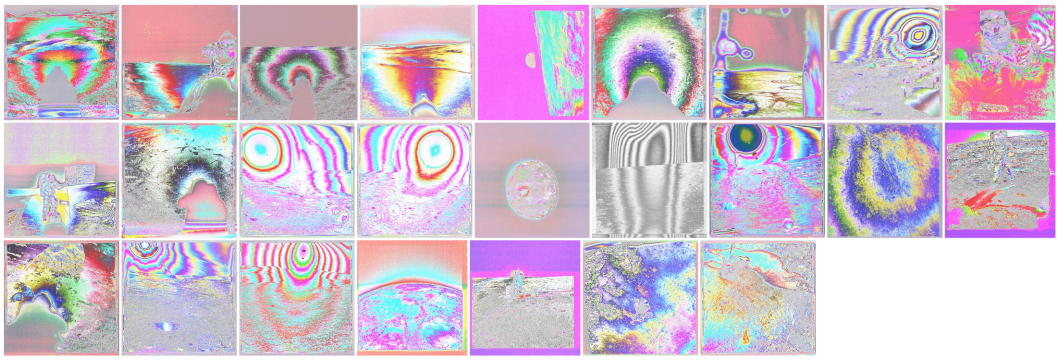


Figure 37. The moon landing photos exhibit forensic patterns that vary widely—deviating from natural sunlight characteristics and aligning more closely with studio lighting.

Q: Can this technique be replicated?

A: Yes. All scripts and datasets are publicly available. The core idea is simple and anyone with access to image editing or programming tools can perform the process. The author has uploaded over 13,000 images on Flickr and provided DOI-linked datasets for transparency.

Q: What are some key findings using this technique?

A: One standout observation is that images of the sun taken on Earth, underwater, and in orbit all show similar degradation patterns, while those from the moon do not. This raises questions about authenticity, suggesting either heavy post-processing or artificial lighting. Similar tests with light bulbs show comparable patterns to those seen in Apollo surface images.

Q: How are "turbulence," "spikes," or "uniformity" quantified rather than visually judged?

A: These characteristics are interpreted as spatial intensity distribution patterns.

- **Turbulent structure** corresponds to high local variance in intensity gradients, indicating strong radiative energy and complex scattering behavior.
- **Spiked structures** reflect rapid directional intensity changes, often associated with high-energy or radiometrically complex sources.
- **Uniform distributions** exhibit low spatial variance and smooth radial falloff, consistent with localized artificial illumination.

Thus, classification is based on the degree of spatial variability and gradient complexity rather than subjective visual interpretation.

Q: Is IDA a filter?

A: No. The method performs differential comparison between an original image and a degraded derivative. The difference map is then amplified through exposure and gamma scaling. This reveals structural information already present in the image rather than applying an interpretive visual transformation.

Q: Does IDA detect manipulation?

A: Yes. It can reveal structural inconsistencies resulting from compositing, editing, or artificial illumination. In some contexts, it provides clearer artifact separation than conventional compression-based methods.

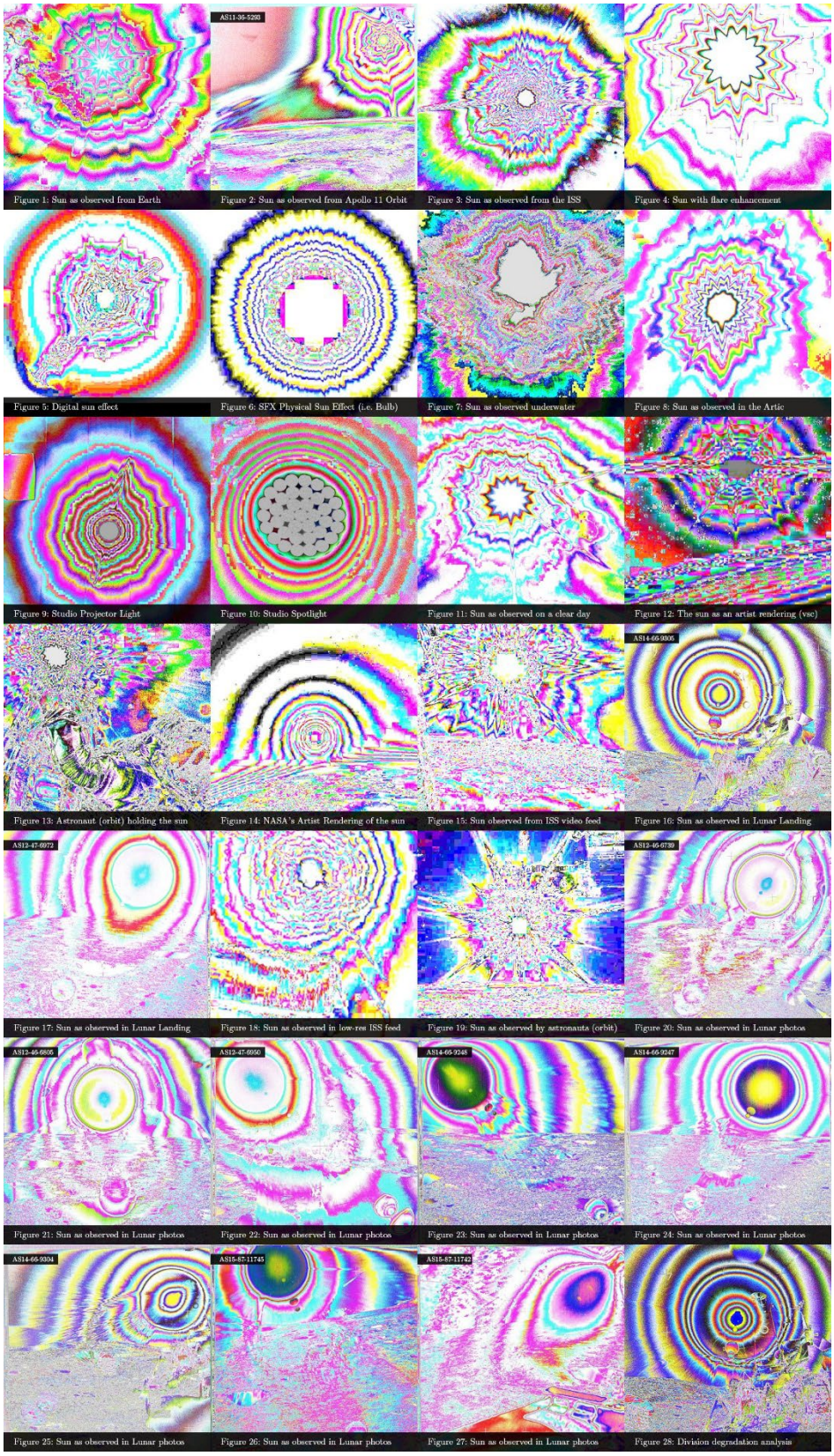


Figure 1: Sun as observed from Earth
Figure 2: Sun as observed from Apollo 11 Orbit
Figure 3: Sun as observed from the ISS
Figure 4: Sun with flare enhancement
Figure 5: Digital sun effect
Figure 6: SFX Physical Sun Effect (i.e. Bulb)
Figure 7: Sun as observed underwater
Figure 8: Sun as observed in the Artic
Figure 9: Studio Projector Light
Figure 10: Studio Spotlight
Figure 11: Sun as observed on a clear day
Figure 12: The sun as an artist rendering (vsc)
Figure 13: Astronaut (orbit) holding the sun
Figure 14: NASA's Artist Rendering of the sun
Figure 15: Sun observed from ISS video feed
Figure 16: Sun as observed in Lunar Landing
Figure 17: Sun as observed in Lunar Landing
Figure 18: Sun as observed in low-res ISS feed
Figure 19: Sun as observed by astronauts (orbit)
Figure 20: Sun as observed in Lunar photos
Figure 21: Sun as observed in Lunar photos
Figure 22: Sun as observed in Lunar photos
Figure 23: Sun as observed in Lunar photos
Figure 24: Sun as observed in Lunar photos
Figure 25: Sun as observed in Lunar photos
Figure 26: Sun as observed in Lunar photos
Figure 27: Sun as observed in Lunar photos
Figure 28: Division degradation analysis

Figure 38. Forensic Analyses of the Sun, Artificial Light Sources, and the Sun on the Moon

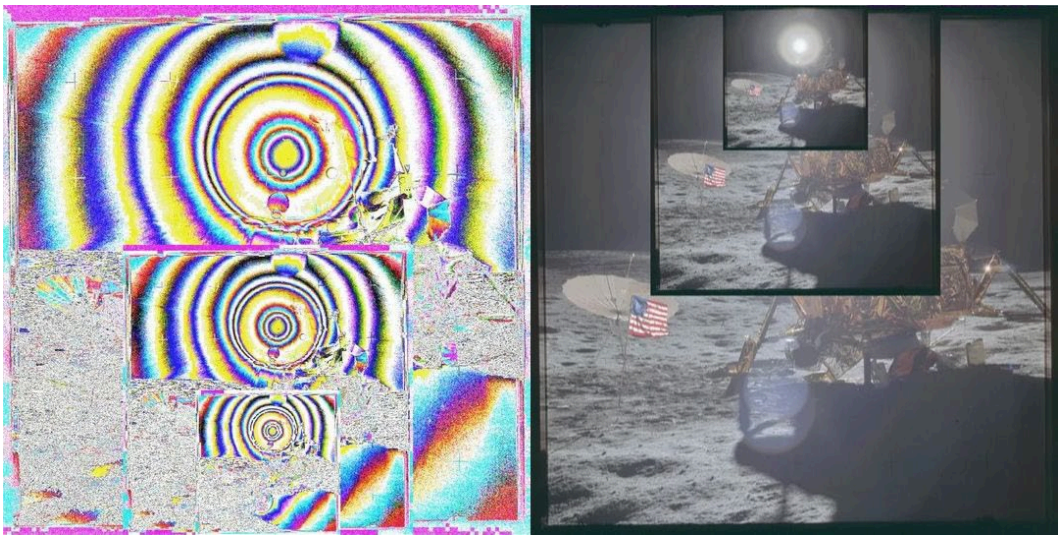


Figure 39. Comparative analysis of multi-resolution image processing using IDA

Q: Is the degradation step deterministic or user-adjustable?

A: The processing pipeline is deterministic. Identical inputs processed under identical parameters produce identical outputs. Image resolution or scaling does not alter the structural illumination signatures revealed by the method, although spatial detail scales proportionally.

Q: Logical chain: compression = light physics?

A: Illumination produces geometric energy distributions across surfaces. Intensity decreases with distance, and different wavelengths are absorbed at different rates. These processes generate structured radial and directional gradients. Normally these gradients appear visually smooth due to diffusion. Extreme compression collapses neighboring pixel differences, exaggerating the underlying gradient geometry. This effectively reduces diffusion and reveals the structural energy distribution that produced the illumination. Because different light sources produce different spatial energy distributions, their structural signatures become distinguishable after degradation.

Essentially: light leaves a physical "fingerprint" on every surface it touches, but these prints are usually too smooth to see with the naked eye. By intentionally "breaking" a digital image with extreme compression, we strip away the smooth surface details and reveal the raw mathematical skeleton of the light that produced the scene. Because distant sunlight hits a planet in a massive, flat wall of parallel rays, it creates a chaotic and spread-out signature. In contrast, artificial lights like studio bulbs are much closer and smaller, which forces them to leave behind perfect, concentrated "rainbow rings" and sharp hot spots. IDA allows us to see if the light in a photo follows the laws of nature or if it shows the telltale signs of a localized, artificial source.

Q: What distinguishes a hotspot from saturation clipping?

A: A hotspot represents a spatially localized region of concentrated radiative intensity characterized by structured falloff. Saturation clipping is a sensor or encoding limit where values are truncated uniformly. When processing is applied globally and uniformly, true illumination structure remains recoverable, whereas clipping produces flat regions lacking gradient structure.

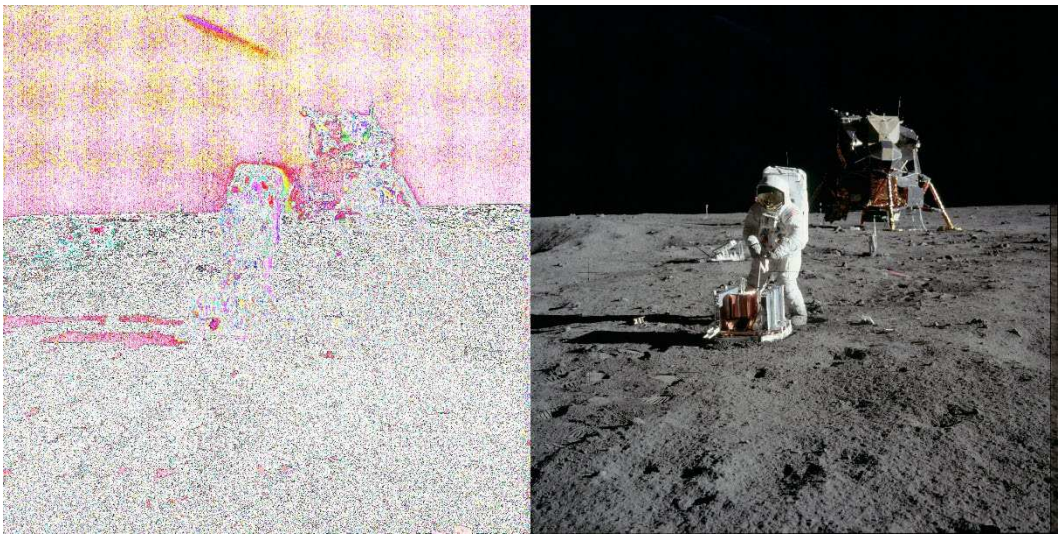


Figure 40. In a full-sized, uncompressed state, forensic analysis reveals a distinct grid pattern that is highly suspicious and indicative of a potential doctoring process.

Q: Does compression alter results?

A: Compression removes information, but the structural illumination relationships generally remain detectable. Information loss is typically insufficient to eliminate large-scale illumination geometry.

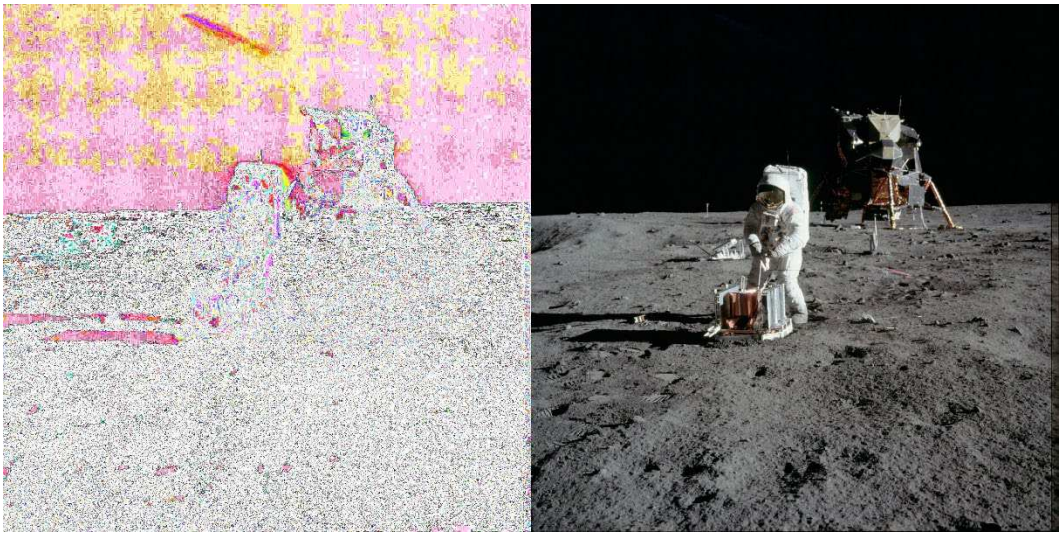


Figure 41. Upon applying **heavy compression** before processing with IDA, these grid patterns collapse and become nearly unrecognizable, yet the essential structural light forensic data remains intact for analysis.

Q: Are there any anomalies which you haven't figured out yet?

A: Yes, A recurring grid-like pattern appears in multiple lunar surface images after IDA processing. This structure has not been observed in other datasets analyzed, including imagery from other spaceflight missions or terrestrial sources. The pattern also does not occur in the broader corpus of tens of thousands of images processed under identical conditions.

Observational Characteristics

- Appears only in specific lunar surface image sets
- Persists across repeated processing runs
- Independent of image most resolutions or scaling
- Not reproduced in control datasets

Current Status
The origin of this structure remains undetermined.
One working hypothesis is that the pattern may reflect a residual artifact introduced

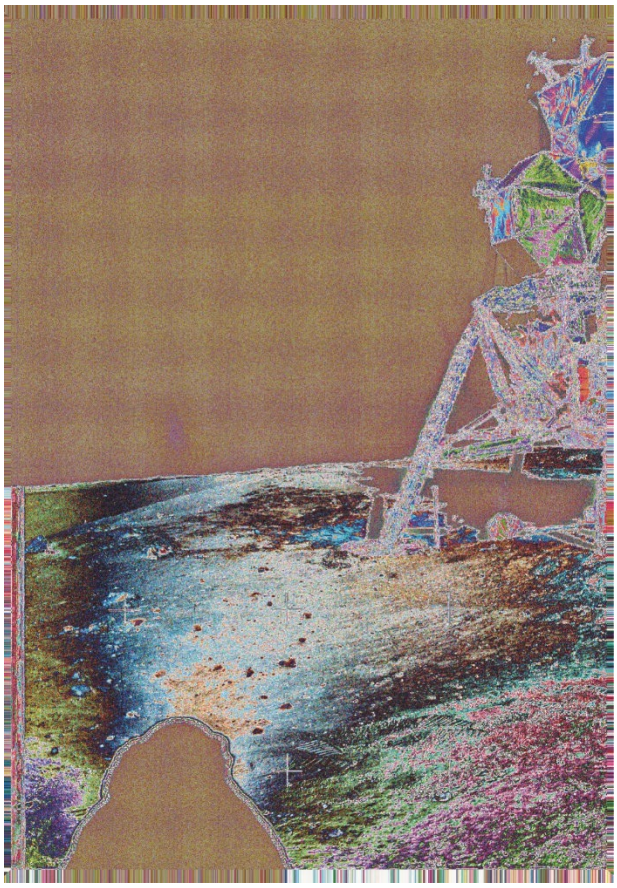


Figure 42. **88.7% compression** prior to processing; note the **grid pattern** is still visible; and also notice the **hot spot** emanating from behind the astronaut's head toward the background.

Q: What constitutes a validated control dataset for natural sunlight?
A: A control dataset consists of images processed strictly under the standardized pipeline with no editing, parameter deviation, or preprocessing beyond the defined method. Consistency of processing conditions is the defining validation criterion.

Q: Are you modifying the image and introducing the hotspots?

A: Actually, these hotspots exist in the original data regardless of the analytical method used. One alternative way to reveal uneven luminosity intensity is by "squeezing" the levels to isolate specific brightness ranges. While a standard image might look consistent to the naked eye, narrowing the levels exposes a massive discrepancy between the outer areas and a centralized region shaped exactly like a directional light source. The Image Degradation Analysis (IDA) output shown on the right captures these intensity levels innately. Unlike selective functions that pick and choose which data to exclude, IDA processes the entire image as is, drawing out the natural structural signatures of the light without human intervention.

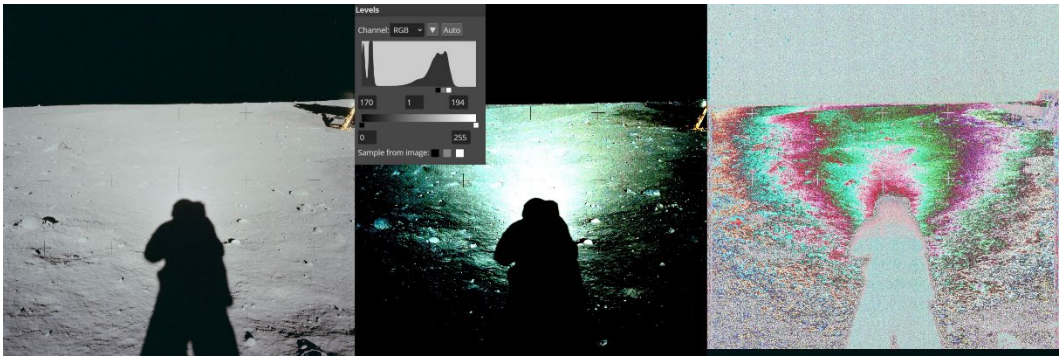


Figure 43. A comparison of three images: the original photo, a version with adjusted levels to expose uneven lighting intensity, and the IDA processed photo without level adjustments

Q: Can't you do this with all images?

A: Yes, it is possible to create something that appears to have distorted light patterns, but a distinct difference remains. Below is an example of a naturally lit scene where the shadowy areas are blackened and the areas touched by light are red. When applying this to the image above, the result is the same: a cone of light is produced with no rhyme or reason. It does not follow the shadows because it is significantly lighter than the surrounding scene, which is not indicative of natural sunlight.

Figure 44. Comparison of light behavior in natural versus artificial environments

Q: Can you summarize what this does?

A: The JPEG compression algorithm reduces image information by merging pixels with similar color and luminance values. When compression is increased to extreme levels (e.g., a quality of 5%), neighboring pixel values are forced to collapse into shared representations. This collapse is not random; it follows the underlying spatial organization of the color gradients. Therefore, by intentionally "breaking" the image with extreme compression, IDA strips away smooth surface details to reveal the raw "mathematical skeleton" of the light source.

Q: What's the best way to understand or test this for myself?

A: Visit the Streamlit portal (https://pemimage.streamlit.app), download the code, and run comparisons on your own image sets. Start with known sources of light (the sun, light bulbs) and observe how they degrade. Then try analyzing archival images, including those from NASA or other sources.

There is an updated version of the tool here: https://andylehti.github.io/ida-forensics/

Appendix A

Appendix A1.1 Solar Analysis

Image Degradation Analysis of Solar Imaging Across Variable Angles

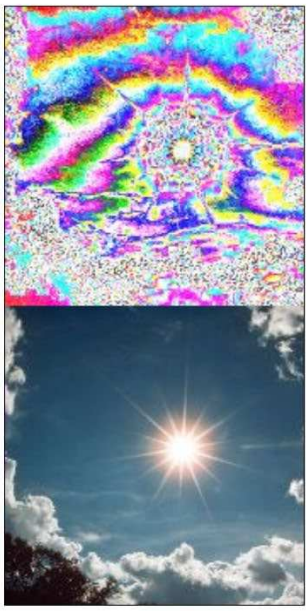


Figure 1.1

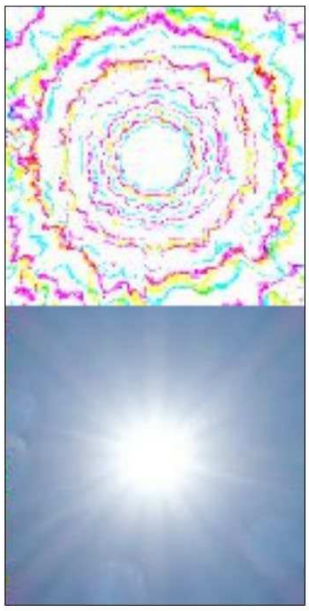


Figure 1.2

Figure 1.3

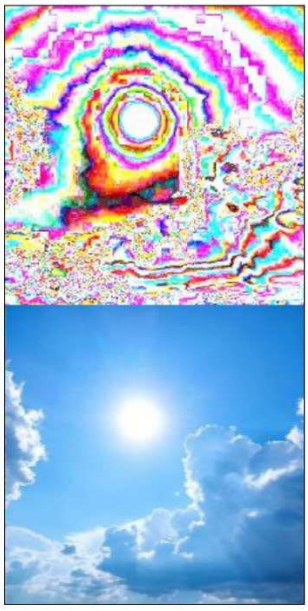


Figure 1.4

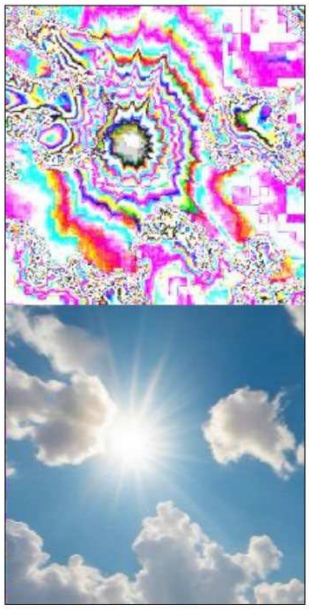


Figure 1.5

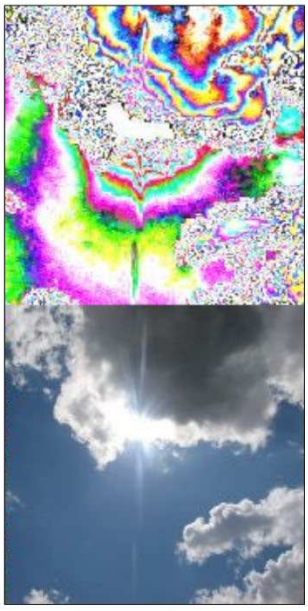
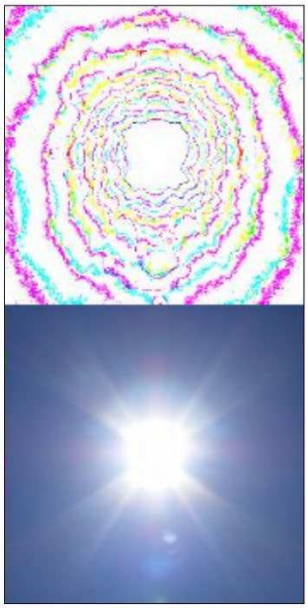


Figure 1.6



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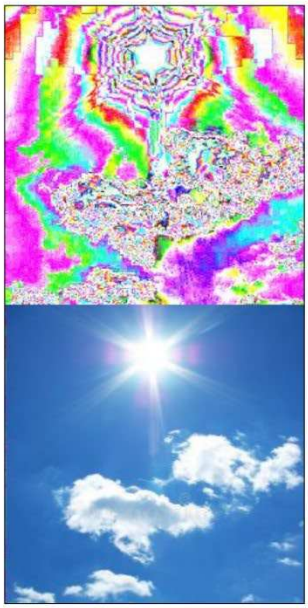


Figure 1.8

Figure 1.9

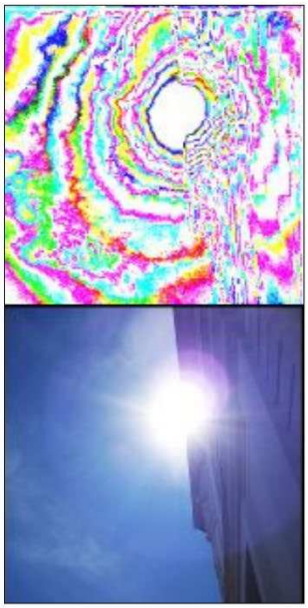


Figure 1.10

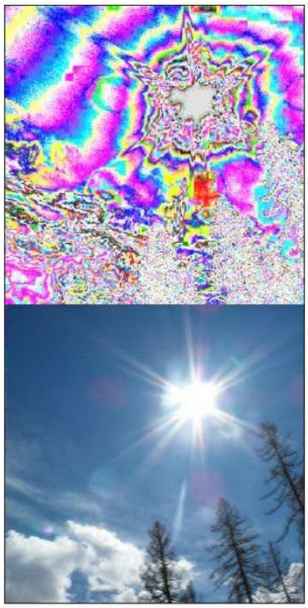


Figure 1.11

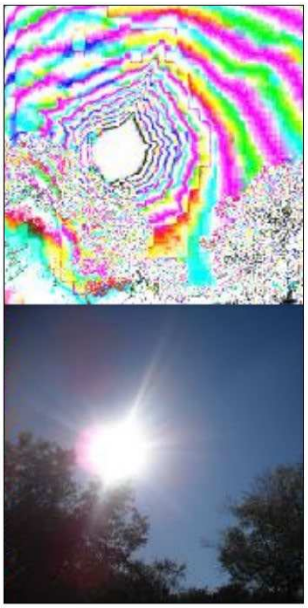


Figure 1.12

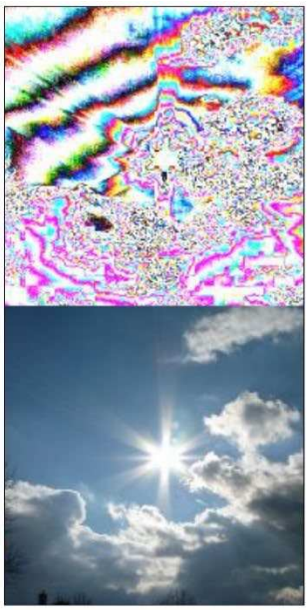
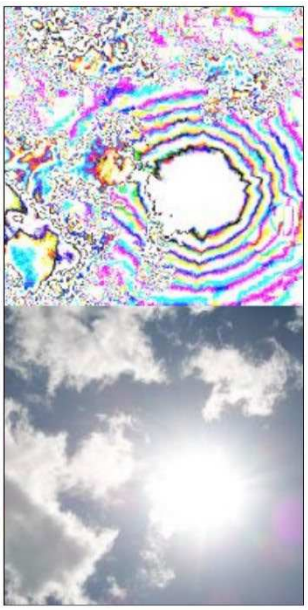


Figure 1.13

Figure 1.14



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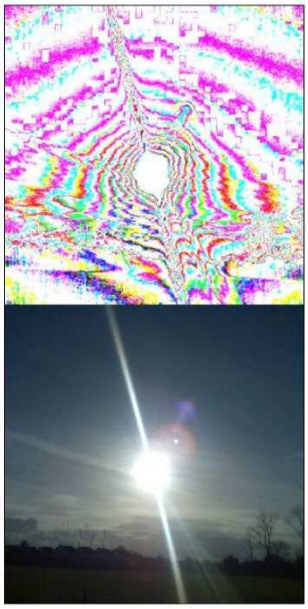

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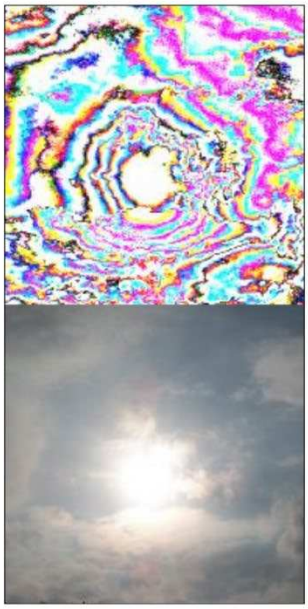

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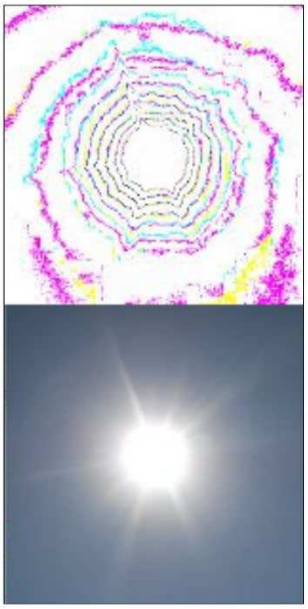

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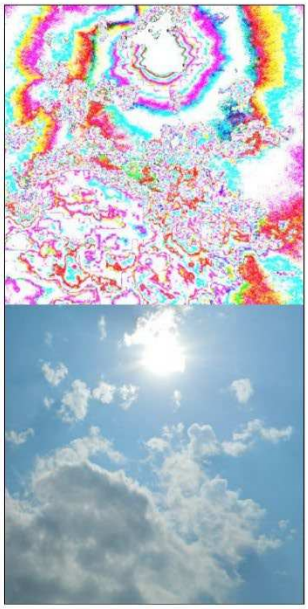

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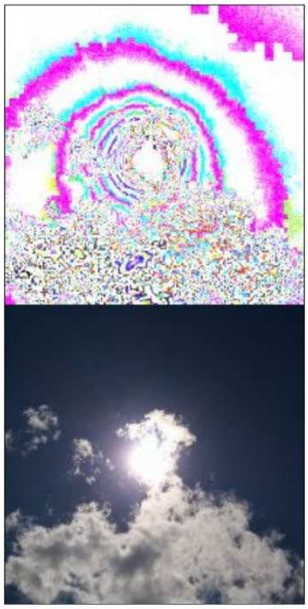

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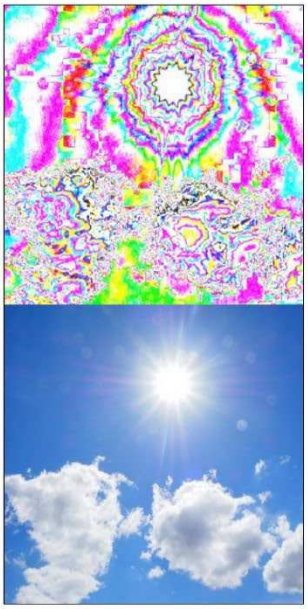


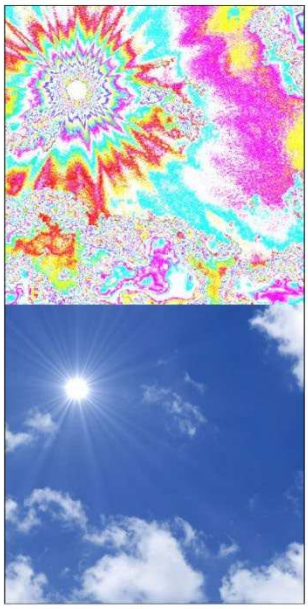
Figure 1.21

Figure 1.22

Figure 1.23

Figure 1.24

Figure 1.25



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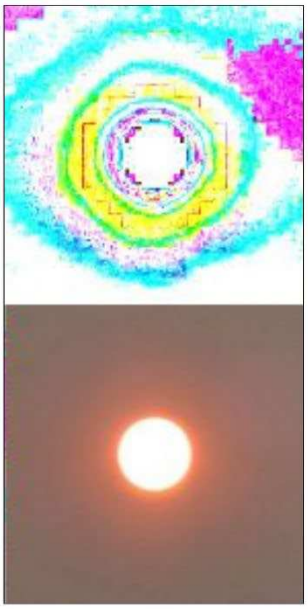

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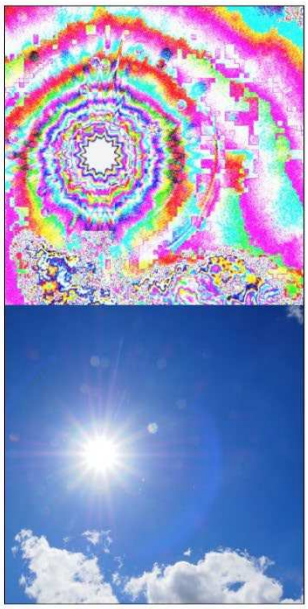

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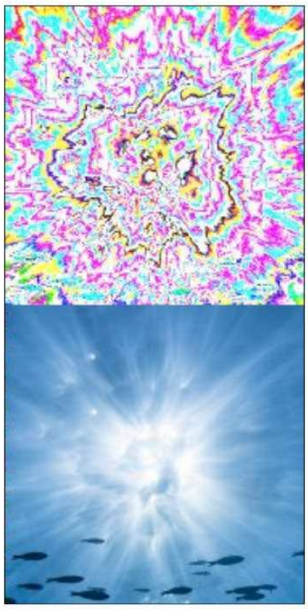

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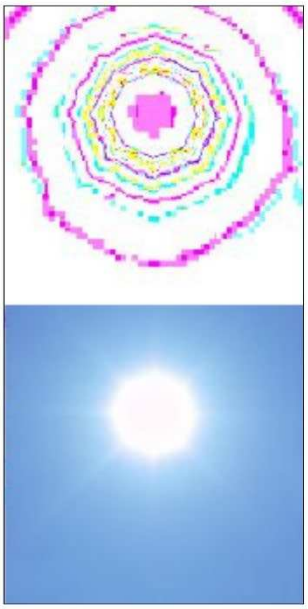


Figure 1.30

Figure 1.31

Figure 1.32

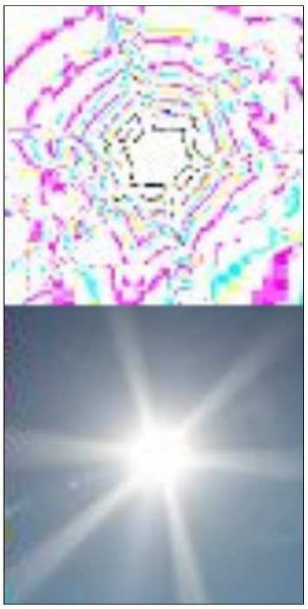


Figure 1.33

Figure 1.34

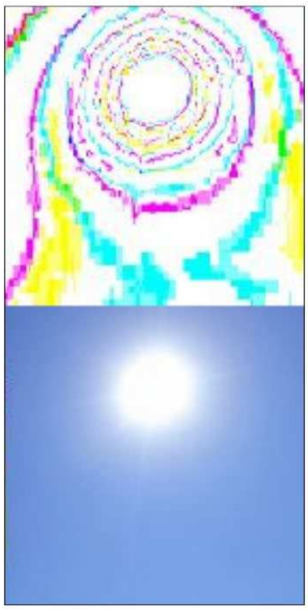
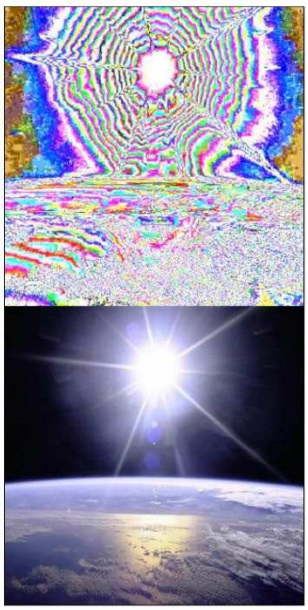


Figure 1.35

Figure 1.36



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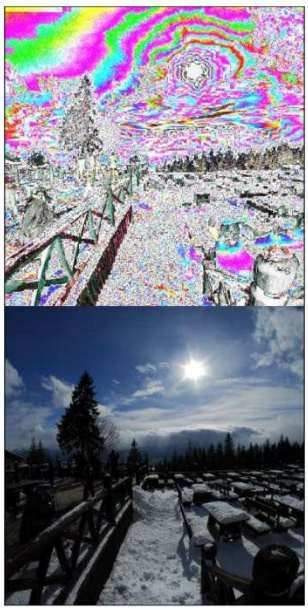
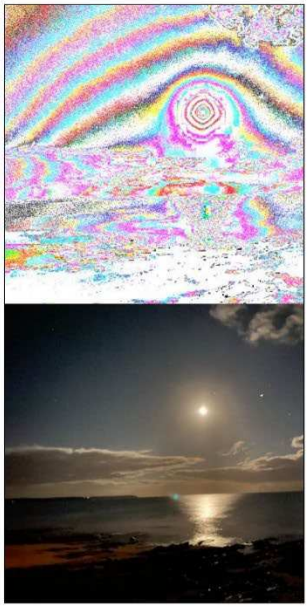


Figure 1.38

Figure 1.39



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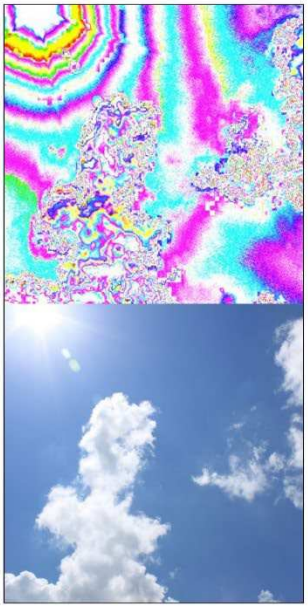

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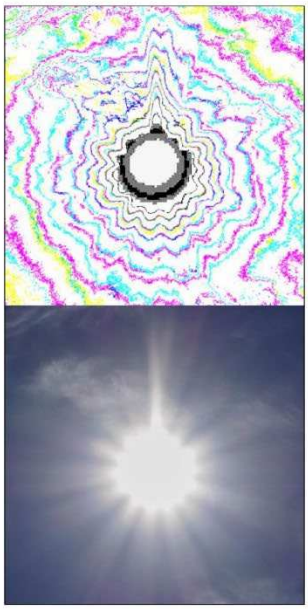

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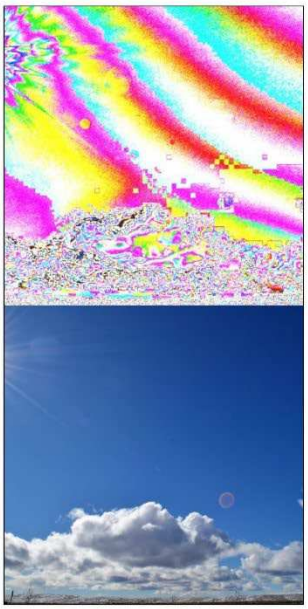
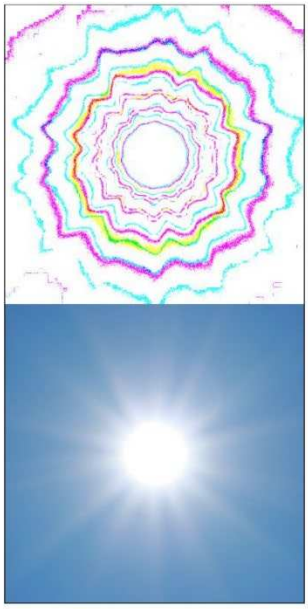


Figure 1.45

Figure 1.46



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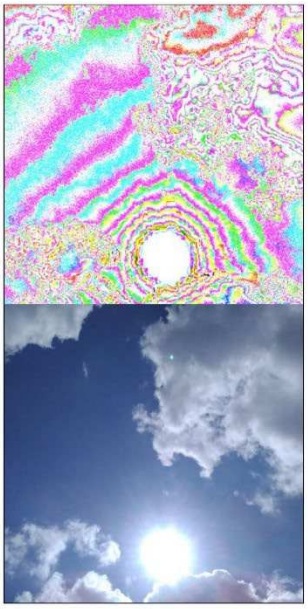

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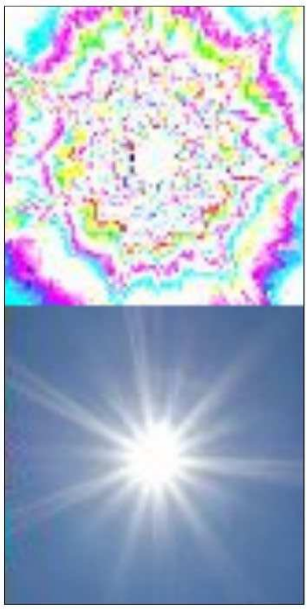

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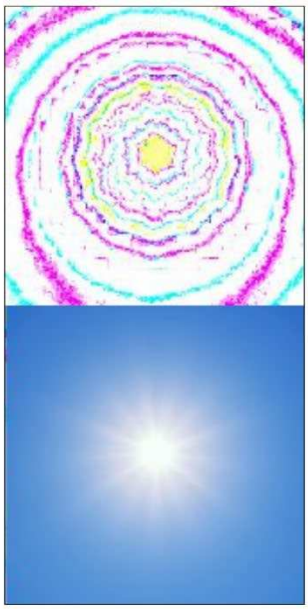


Figure 1.50

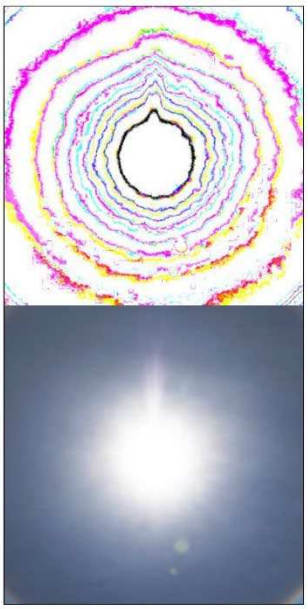


Figure 1.51

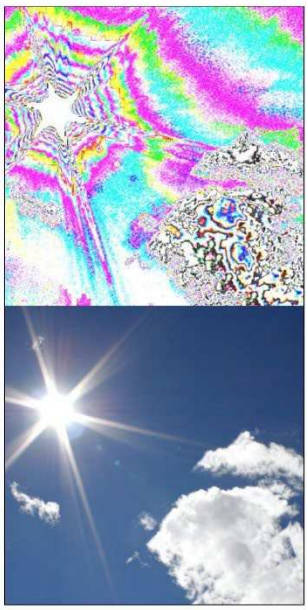


Figure 1.52

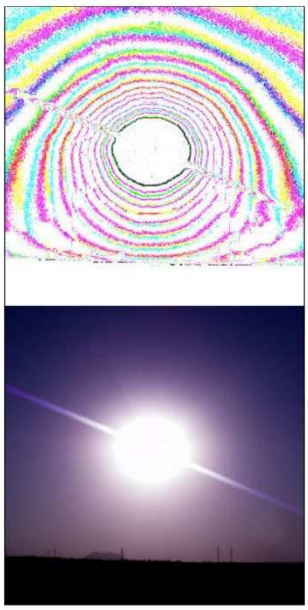


Figure 1.53

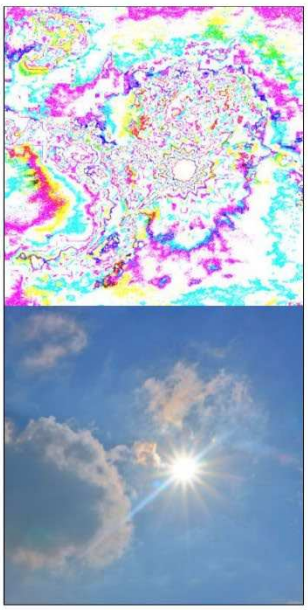


Figure 1.54

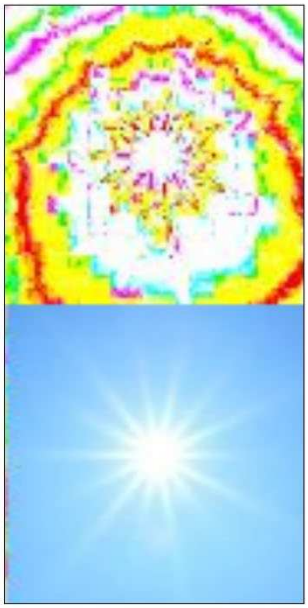


Figure 1.55

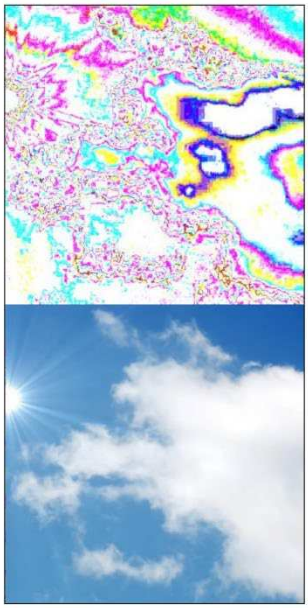


Figure 1.56

Appendix A2.1 Studio Lighting

Controlled Studio Illumination Under Image Degradation Analysis

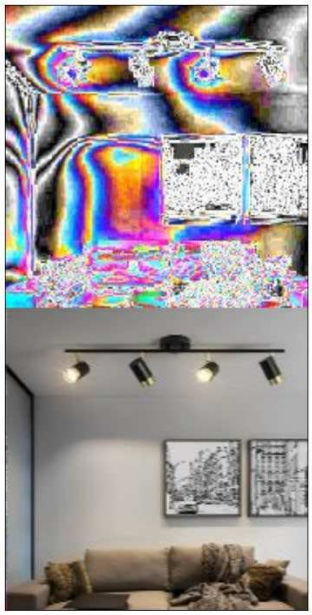


Figure 2.1

Figure 2.2

Figure 2.3

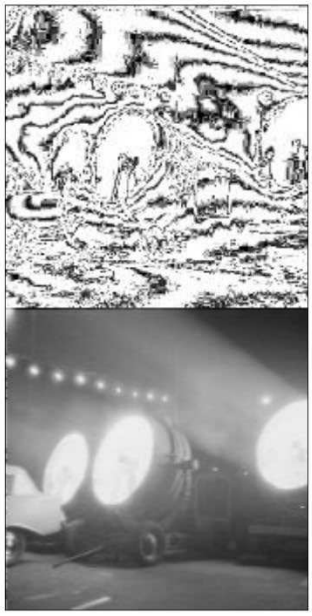


Figure 2.4

Figure 2.5

Figure 2.6

Figure 2.7

Figure 2.8

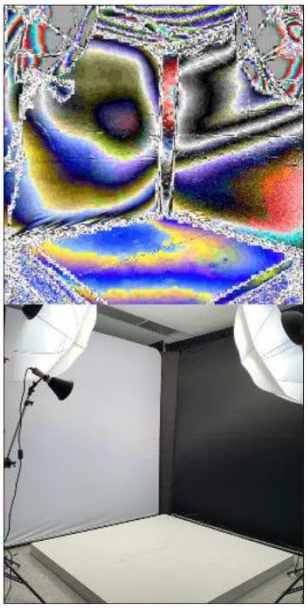


Figure 2.9

Figure 2.10

Figure 2.11

Figure 2.12

Figure 2.13

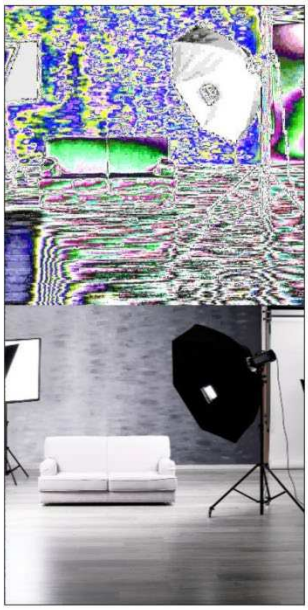


Figure 2.14

Appendix A3.1 Outside Photographs

Field-Based Image Degradation Analysis: Non-Occurrence of Hot Spots

Figure 3.1

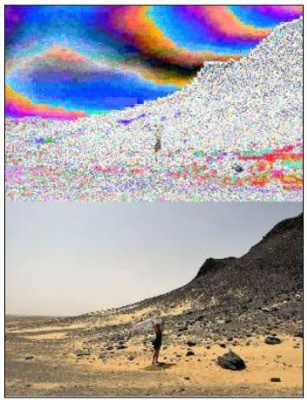


Figure 3.2

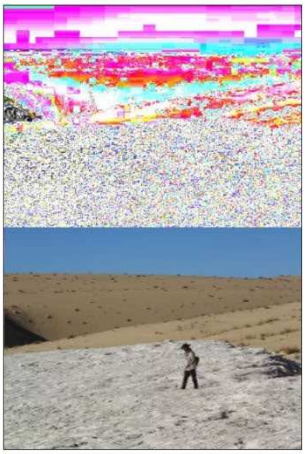


Figure 3.3

Figure 3.4

Figure 3.5

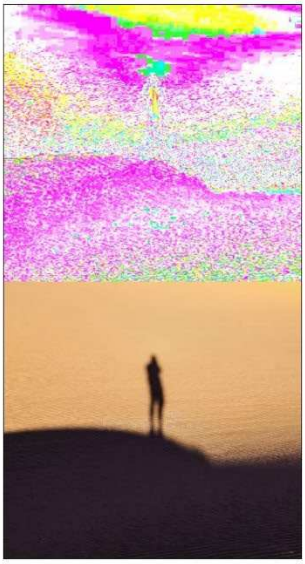


Figure 3.6

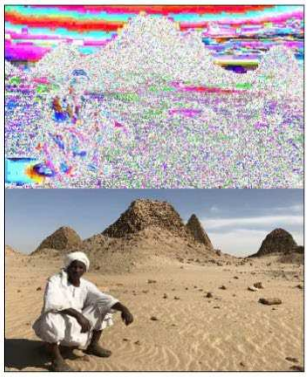


Figure 3.7

Figure 3.8

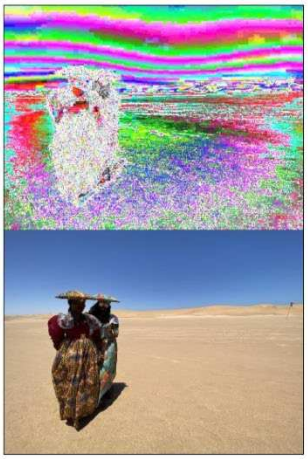


Figure 3.9

Figure 3.10

Figure 3.11

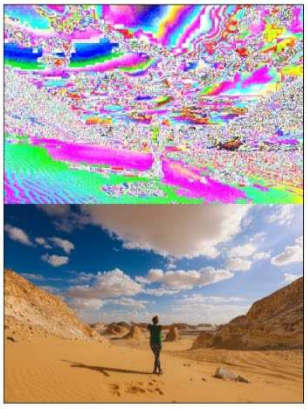


Figure 3.12

Figure 3.13

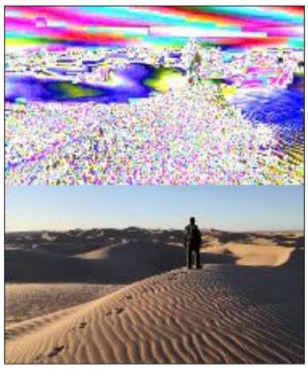


Figure 3.14

Figure 3.15

Figure 3.16

Figure 3.17

Figure 3.18

Figure 3.19

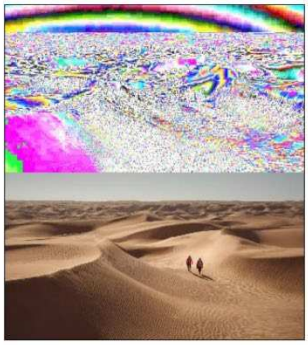


Figure 3.20

Figure 3.21

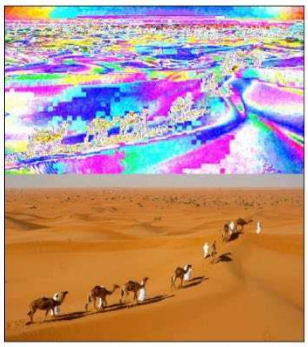


Figure 3.22

Figure 3.23

Appendix A4.1 Artificial Light

Degradation Analysis of Controlled Artificially Lit Environments

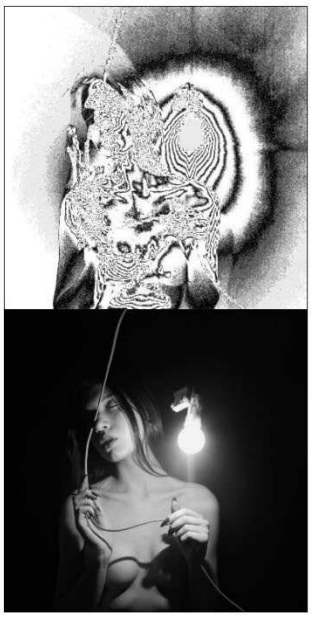


Figure 4.1

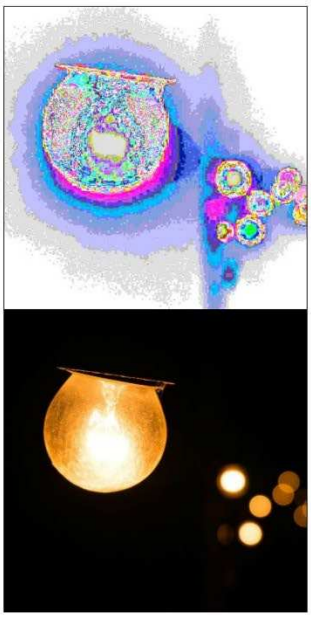


Figure 4.2

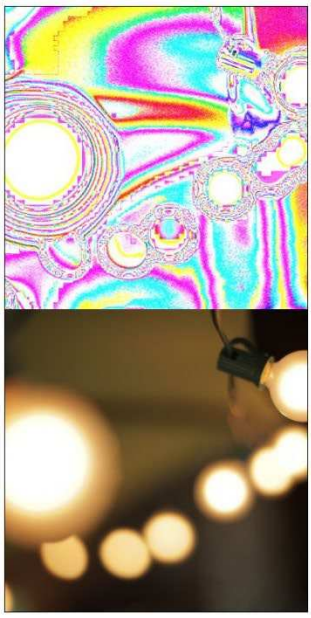


Figure 4.3

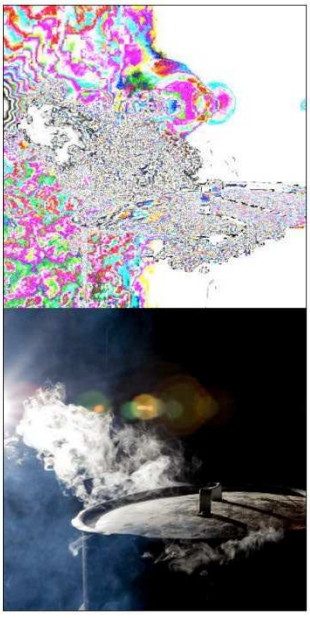
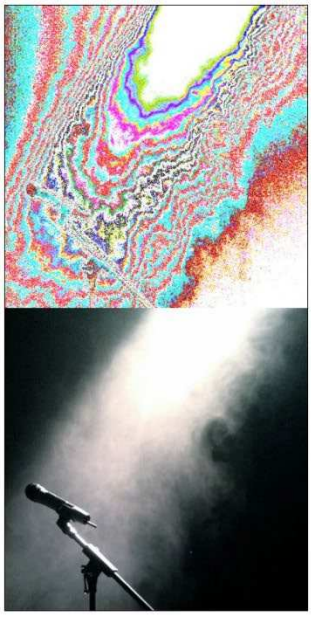


Figure 4.4

Figure 4.5



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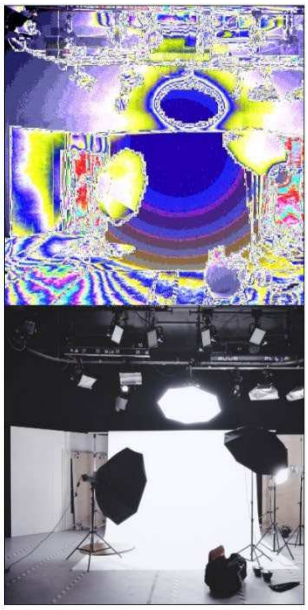


Figure 4.7

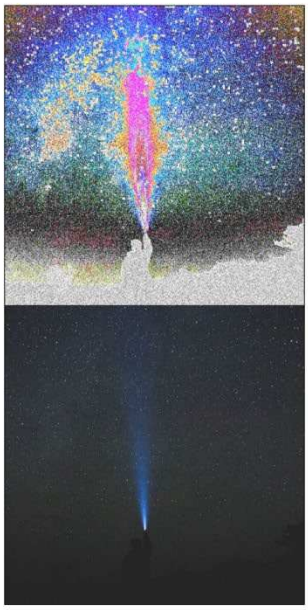


Figure 4.8

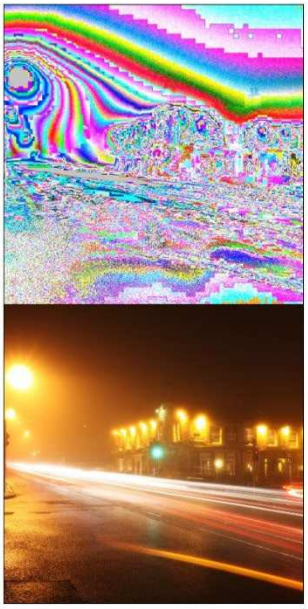


Figure 4.9

Figure 4.10

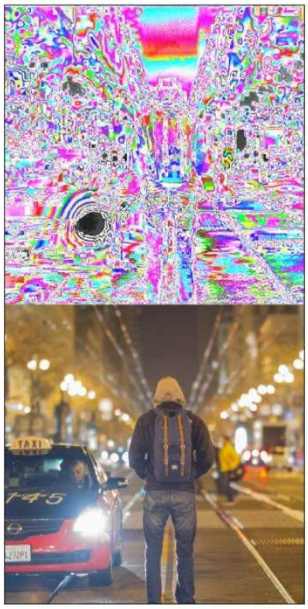


Figure 4.11

Figure 4.12

Figure 4.13

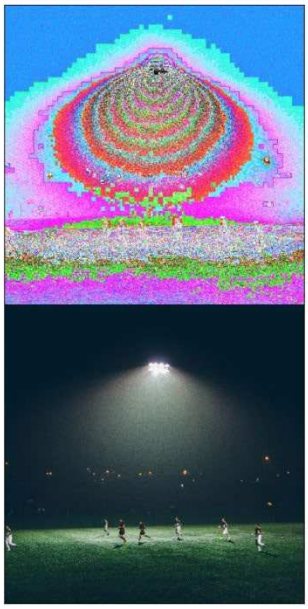


Figure 4.14

Figure 4.15

Figure 4.16

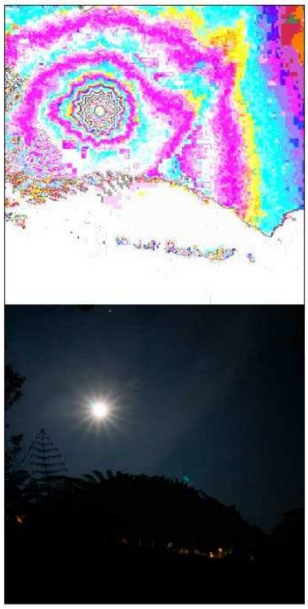
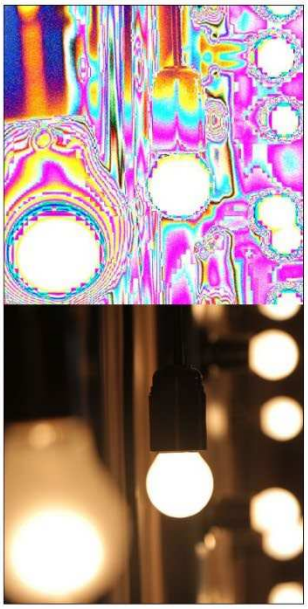


Figure 4.17



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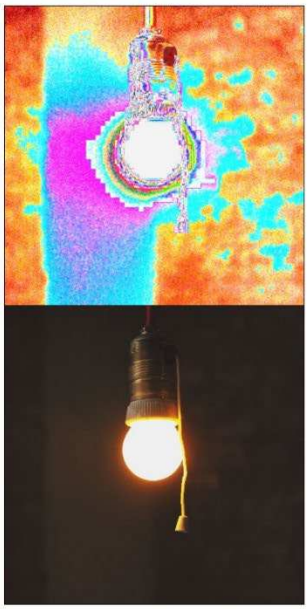


Figure 4.19

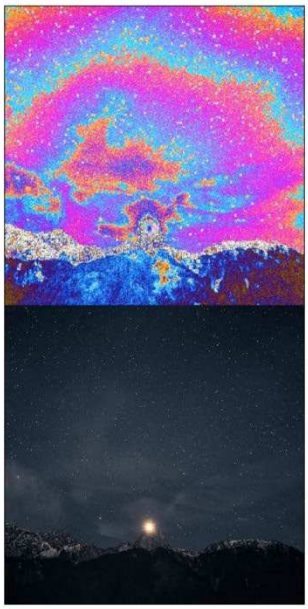


Figure 4.20

Figure 4.21

Figure 4.22

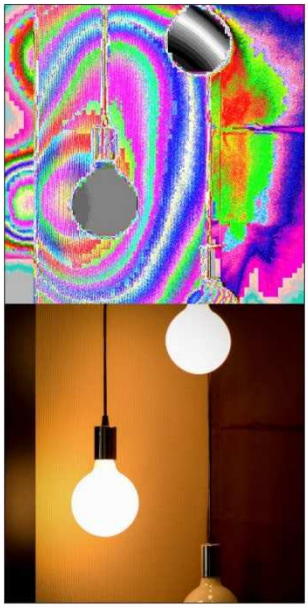


Figure 4.23

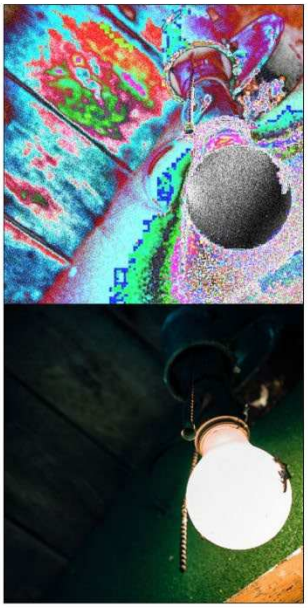


Figure 4.24

Appendix A5.1 Solar Space Analysis

Forensic Examination of Solar Light Characteristics in Apollo and ISS Imagery

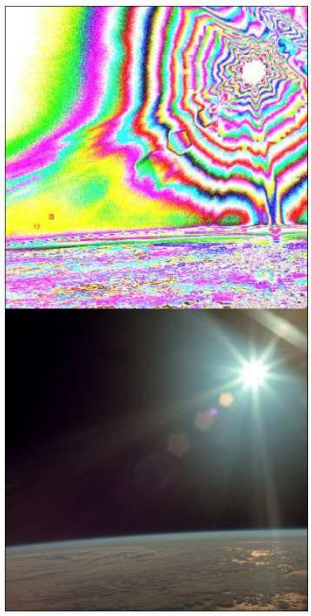


Figure 5.1

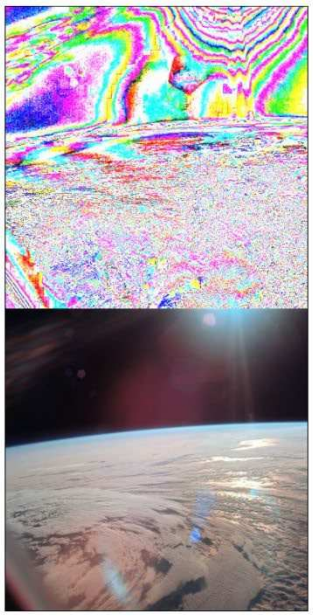


Figure 5.2

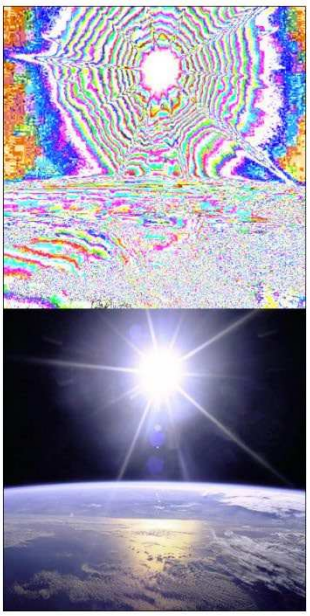


Figure 5.3

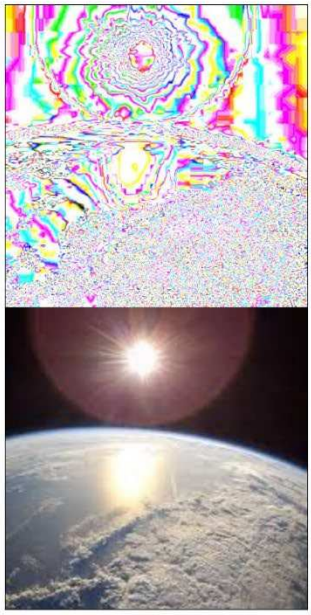


Figure 5.4

Figure 5.5

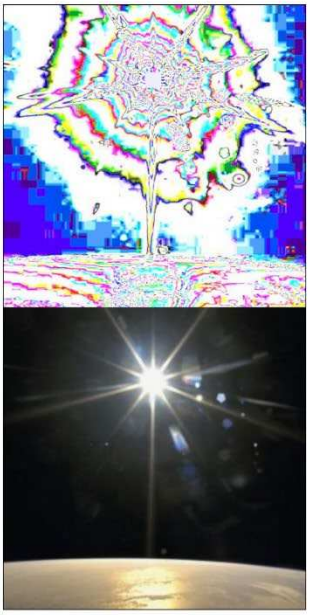


Figure 5.6

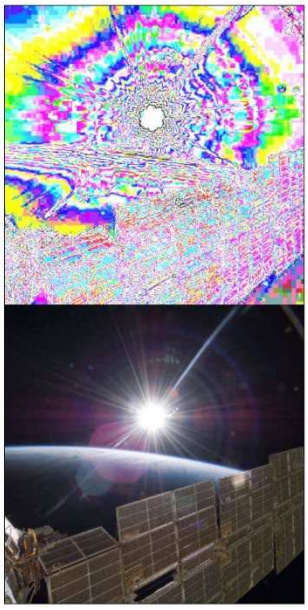


Figure 5.7

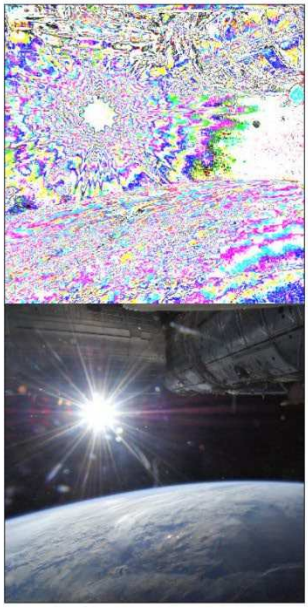


Figure 5.8

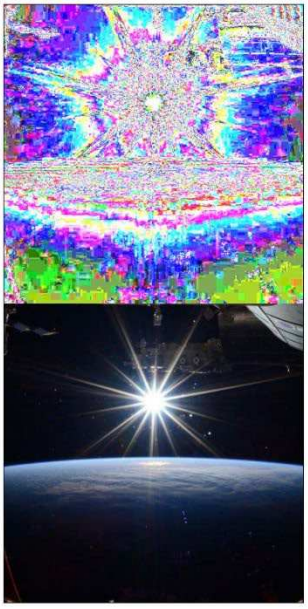


Figure 5.9

Figure 5.10

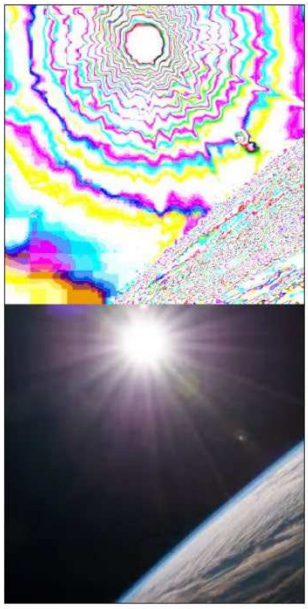
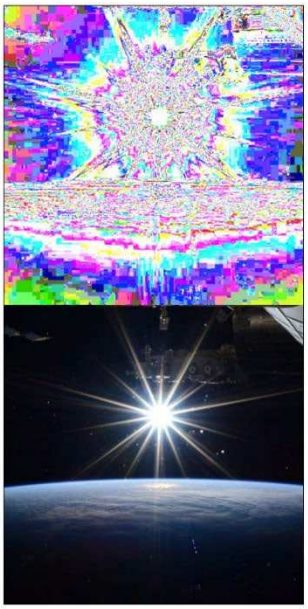


Figure 5.11

Figure 5.12

Figure 5.13

Figure 5.14



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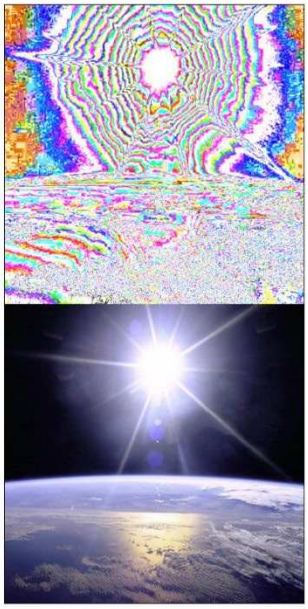

Figure 5.16